THE BOSTON Medical and Surgical JOURNAL

OFFICIAL ORGAN of THE MASSACHUSETTS MEDICAL SOCIETY and of THE NEW ENGLAND SURGICAL SOCIETY

$6 per Annum. 25c per copy
Vol. CLXXXIV, No. 9

THURSDAY, MARCH 3, 1921

Published weekly in Boston, at 126 Massachusetts Avenue

R 11 N57 v.184 no.9 cop.2

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Current Literature Department

MEDICINE.

A Study of Mercury Injections by Means of the Roentgen Ray.

Cole, H. N., et al. (*Jour. A. M. A.*, Dec. 4, 1920) draw the following conclusions from their work:

1. The absorption of "insoluble" mercury preparations from intramuscular injections can be followed admirably by roentgen ray shadows. The method is not applicable to soluble preparations.

2. An extensive study of clinical cases gave the following as the time when absorption is completed:

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Calomel: Mean, 15 days; extremes, 4 to 39 days.

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The Relative Usage of Narcotic Drugs in Hospital Service and Private Practice.

Blair, J. S. (*Jour. A. M. A.*, Dec. 11, 1920) offers the following recommendations which seem of distinct value:

This is a broad survey, as accurate as the nature of the problem faced has, thus far, made practicable. Permit a few recommendations.

1. There should be more and better rural hospitals.

2. Physicians whose training is defective should be aided to a higher standard of efficiency.

3. The importation and distribution of narcotic drugs for legitimate purposes should be, in my view, under the care of a government bureau; but no government should, through subsidies, etc., participate in the profits of the opium business.

4. Proper limits should be placed on the amounts imported and distributed to physicians, pharmacists, and the like, reducing the amounts through a series of years, finally reaching the actual basis of need.

5. Smuggling of narcotics should be made an offense punishable by imprisonment for not less than five years, never by a mere fine.

6. The internal revenue taxation on narcotics and dealing therein, as established in the United States, should be kept up as a necessity in tracing importations, distribution and usage.

7. Cannabis, hyoscyamus, hydrated chloral, and a few synthetic drugs should come under the narcotic control laws, and no narcotic drugs whatsoever should be permitted in proprietary preparations and products sold without prescription. Exemptions lead to abuses.

8. Drug peddling in every shape and form should be sternly met with heavy jail sentences, never by the imposition of a mere fine.

9. The so-called ambulatory reduction treatment of drug addiction is rarely of any value and should not be permitted under the laws designed to control addiction; but the drug addicts should, in some way, be hospitalized or humanely taken care of in proper institutions. [E. H. R.]

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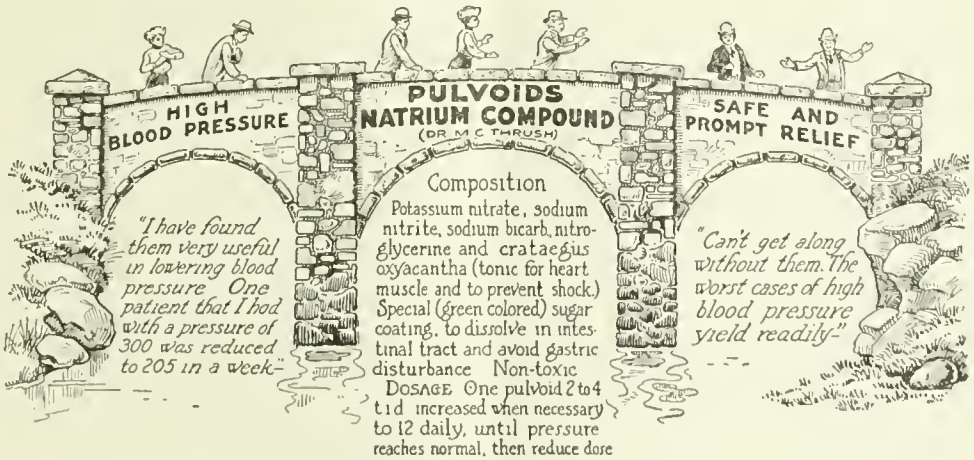
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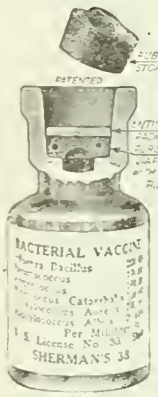

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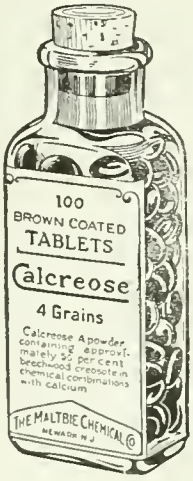

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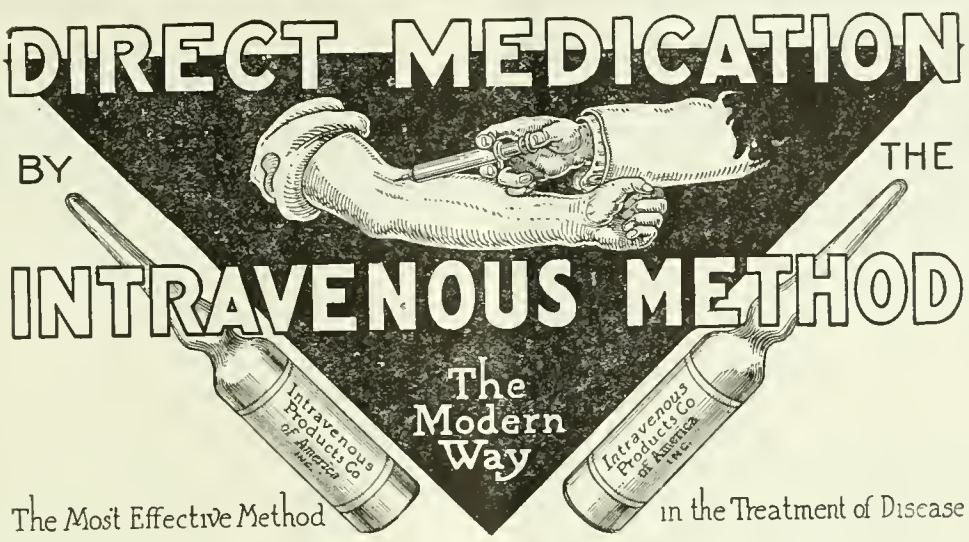

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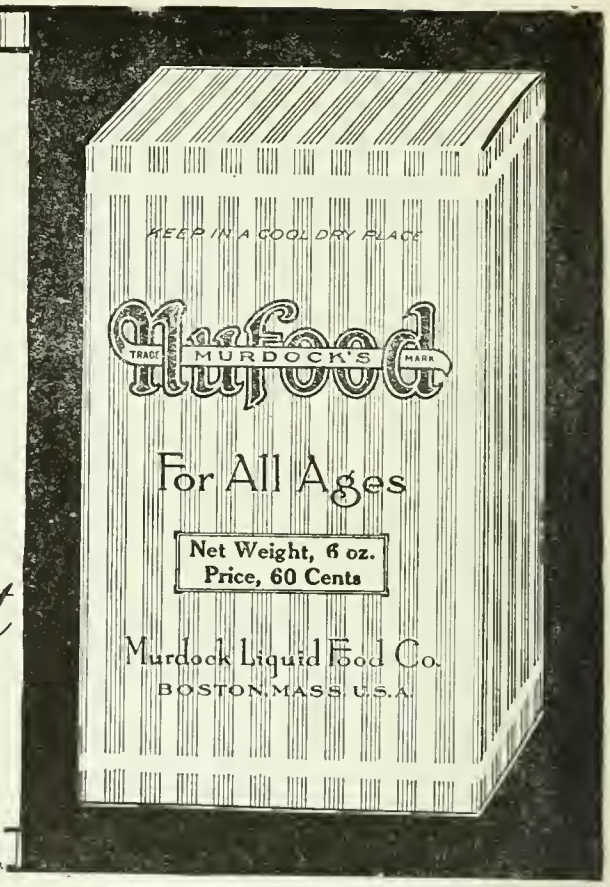

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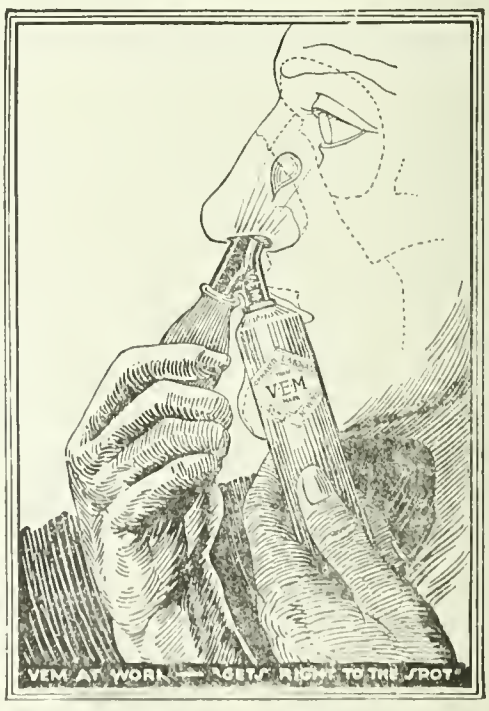

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Original Articles.

THE ENERGY REQUIREMENTS OF GIRLS FROM 12 TO 17 YEARS OF AGE.

By Francis G. Benedict and Mary F. Hendry, Boston.

[From the Nutrition Laboratory of the Carnegie Institution of Washington, Boston, Massachusetts.]

The Nutrition Laboratory has had for one of its major problems the determination of the basal metabolism of humans from birth to old age. The earliest[1] of its contributions to this problem was the accumulation of a considerable number of metabolism measurements on young people of both sexes at about the college age, as at this age subjects were readily available for observations. Basal values were also usually found in connection with other inquiries, although not infrequently effort was made to obtain basal values *per se*. To secure observations at ages other than the college age required definite, special experiments. The determination of the metabolism of new-born infants necessitated our intimate association with the Boston Lying-In Hospital, where this problem was studied with approximately one hundred infants of both sexes. The years of early childhood from birth to two years of age were studied with a large number of infants at the Massachusetts Wet-Nurse Directory, and from two to twelve years of age at the New England Home for Little Wanderers. The gap between 12 years and the college age, 18 or 19 years, was noticeable when an attempt was made to plot any curves for the general trend of metabolism of males and females.

Since the earlier literature contains but very little of basal value in the study of the metabolism of children of this age range, and particularly since the metabolism of girls has been considered experimentally very much less than that of boys, it seemed desirable, if possible, to begin our observations with girls. A second incentive for studying girls was the lack of connection between the curve indicating the trend of metabolism of girls from birth to 12 years of age and the general slope of the line indicating that of women. Based on the individual measurements of boys and girls made by Benedict and Talbot,[2] curves were drawn showing the most probable trend of metabolism when compared with age and weight, on the several bases commonly used for comparative purposes. With girls, as well as with boys, reasonable uniformity and regularity was shown from birth to 12 years of age, but from the abnormal trend of the line for girls after this age it was especially emphasized that the number of girls

measured over 12 years of age and below 17 years was altogether too small to warrant any general deductions, and it was this part of the curve that up to the present time remained practically uncharted.

With boys it has been found that the most probable basal metabolism of a boy from one to thirteen years can be estimated with a considerable degree of accuracy from the biometric formula of Harris,[3] derived from the analysis of the metabolism of a large number of men. Indeed there is every probability that the prediction by this formula likewise holds true for boys from 13 years to 19 or 20 years of age. The consistent irregularity in predicting the heat of women from the Harris-Benedict formula for women makes all estimates using this formula of very much less value than those using the formula for male adults, and since the prediction of the heat for young girls from 2 to 12 years of age from the formula for women gives results entirely discordant with the facts, one cannot infer that with a higher age range from 12 to 20 years the formula for women will necessarily predict the most probable basal heat. Moreover, a clear sexual differentiation was shown by the comparison of the metabolism of boys and girls from birth to 12 years of age,[4] and the peculiar sweep of the curve from 8 to 12 years in the case of girls emphasized the importance of studying more particularly girls from 12 to 17 years of age.

PREVIOUS INVESTIGATIONS.

In examining the literature for observations on the metabolism of girls and confining ourselves to those with girls between 12 and 17 years of age, inclusive, we find the earliest studies are those of Andral and Gavarret.[5] These investigators, although overlooking the importance of recording weight and height and making their observations under conditions not basal, report a carbon excretion corresponding to a 24-hour heat production in the case of a girl 13 years of age amounting to 1663 calories, with a girl 15½ years old, 1879 calories, and with another girl, also 15½ years old, 1663 calories. The first two girls had not as yet reached puberty.

The most extended observations on girls were those of Magnus-Levy and Falk,[6] who studied six girls in the age range here under consideration, weighing from 24 to 54 kilograms. With characteristic accuracy they carefully recorded the weights and heights, as well as the data for the metabolism experiments. Hence it is possible, by applying a more recent formula,[7] to compute accurately the body surface area, which still has a fascination for many physiologists as a means of comparing the basal metabolism of different individuals. In Table I herewith are given the metabolism measurements of these girls, together with the ages, heights and weights.

Table I.—Basal Metabolism of Girls (Magnus-Levy and Falk).

Age	Body weight (without clothing)	Height	Pulse rate	Heat (computed) per 24 hours	
				Per kg.	Per sq. m.[1]
yrs.	kgs.	cms.		cals.	cals.
12	24.0	129	76	40.1	1023
12	25.2	128	--	37.2	987
13	40.2	145 ?	84	33.9	1072
13	31.0	138	--	39.3	1106
14	35.5	143	96	36.6	1092
15	54.0	156	--	26.0	923

[1] Computed by us, using body surface areas found from the Du Bois height-weight chart. [2] Somewhat backward in growth. [3] Advanced in development; puberty beginning. [4] Just prior to puberty being established. [5] Puberty established.

EARLIER NUTRITION LABORATORY DATA.

The Nutrition Laboratory has thus far published basal metabolism observations on eight girls ranging in age from 12 to 16 years. Observations on four of these, representing ages 15 and 16 years, respectively, were carried out by Mr. Louis E. Emmes, formerly of the Nutrition Laboratory staff; the observations on the remaining four have been recently published by Benedict and Talbot. The data for these eight girls are given in Table II herewith.

FACTORS AFFECTING THE METABOLISM OF ADULTS AND CHILDREN.

From the preliminary, comparative measurements of Emmes, Roth, and Smith,[1] substantiated by the careful biometric analysis of Harris,[8] it is clear that the basal metabolism of adults is affected independently by at least four factors, sex, weight, height, and age. Of these the influence of weight has long been recog-

TABLE II.—BASAL METABOLISM OF GIRLS PREVIOUSLY STUDIED BY THE NUTRITION LABORATORY.

Subject number	Age	Body weight (without clothing)	Height	Pulse rate	Heat (computed) per 24 hours	
					Per kg.	Per sq. m.
	yrs. mos.	kgs.	cms.		cals.	cals.
2401	11 11	28.8	129	75	36.9	1026.2
2391	12 1.3	39.2	148	72	38.3	1179.2
2511	12 2.4	30.9	139	78	32.8	920.2
2571	13 4	37.1	140	74	35.5	1079.2
235	15 4	56.8	157	65	28.7	1038.6
365	15 6	52.1	162	70	26.0	879.6
395	15 8	51.4	158	77	30.0	1021.6
425	16 5	50.6	162	83	25.2	838.6

[1] See Benedict and Talbot, Carnegie Inst. Wash. Pub. No. 302 1921, p. 123. Subject numbers underlined represent girls who have *not* reached puberty. [2] Computed from body surface areas measured by the Du Bois linear formula. [3] Puberty established. [4] Puberty beginning. [5] See Benedict, Emmes, Roth, and Smith, Jour. Biol. Chem., 1914, Vol. xviii, p. 139. Puberty probably established; no record. [6] Computed from body surface areas obtained from the Du Bois height-weight chart.

nized. The effect of height *per se* is more obscure, since tall people are usually heavier and weight changes would mask any changes due to height alone, and it is only through careful biometric analysis that the height factor can be definitely shown. The influence of age, likewise, is clearly proven, as well as that of sex. With adults the relation between metabolism and each of these factors can be, for the most part, represented by a straight line, although very wide variations occur in all instances. Thus, there is a distinct increase in metabolism with increasing weight and height, and there is a distinct, though slight, decrease with increasing age. With new-born infants on the first day of birth, Benedict and Talbot[9] showed clearly that very low values were found for the metabolism, either per unit of body weight or per unit of surface, until about the age of one creases from there on, per unit of weight and per unit of surface, until about the age of one year, or at a body weight of 10 kilograms, where it begins to fall. From the analysis of the metabolism of adults, made by Harris and Benedict,[8] no peculiar abnormalities were noted at any given age, weight or height, but with children a specifically high metabolism was noted at about the age of one year or the weight of 10 kilograms.

During the later period of growth, from 12 to 17 years, one factor enters into the development of life which produces pronounced psychological as well as physiological alterations in the body, namely, the influence of puberty. That so pronounced a factor should be reflected somewhat in the basal metabolism was seriously considered as early as the days of Andral and Gavarret,[5] who drew rather extensive conclusions from their data, conclusions that unfortunately, owing to the deficiency with which their data are reported, cannot at the present day be verified. Magnus-Levy and Falk,[6] however, recorded most carefully the pubertal changes in the subjects that they studied.

Perhaps the most pronounced effect of approaching puberty upon metabolism is that reported for boys by DuBois, who found a very high specific metabolism with boys at the age of 12 and 13 years, while with the same boys two years later, after puberty was thoroughly established, he found the metabolism was considerably lower.[10] From the fact that there is a high metabolism at 10 kilograms or one year of age, falling off thereafter, one would normally expect that boys, and indeed girls, at 12 years of age would have a slightly higher metabolism than boys and girls two years later. The extraordinarily high values found by DuBois, however, were interpreted by him as being a specific effect of the approaching pubertal changes. It is quite clear, therefore, that serious consideration of the influence of puberty upon the metabolism of young children is a necessary accompaniment of any extended study of the vital activities of youth.

The age factor in basal metabolism is fairly small with adults, that is, the decrease in calories per 24 hours for each year with the average adult is 7.15 for men and 2.29 for women.[11] With young children the influence of age has been shown to be very pronounced, and one can predict that from two years of age on, the metabolism per unit of weight will gradually decrease until it approaches the value for adults. Thus, the influence of age *per se* is of special interest in studying the metabolism of children. But the influence of the various stages of the establishment of puberty must naturally receive special consideration. The study of the metabolism of children, therefore,

between 12 and 17 years of age, is of prime interest in throwing light upon, first, the influence of the establishment of puberty and, second, the influence of age upon metabolism. In our investigation, therefore, both of these factors were taken into serious consideration and the experimental routine purposely planned to study, if possible, the influence of these two factors upon human metabolism.

METHOD OF STUDY.

With the accumulation of data at ages from birth to 12 years and at the college age, it was seen that to complete the picture of basal metabolism from 12 to 17 years with both boys and girls by the earlier method of experimentation, *i.e.,* by studying the individual, would require considerable time. Since the post-absorptive condition and complete muscular repose are prerequisites for the best modern basal metabolism measurements, it is desirable that the subject be without food for 12 hours, that he should come to the laboratory in the morning without breakfast, and remain lying quietly for some time prior to the actual tests. By any of the standard methods the subsequent gaseous metabolism measurements would involve from one and one-half to two hours or more time on the part of the subject and operators.

Furthermore, a study of the basal metabolism of humans[8] has shown that the variation is large, that individual determinations are of prime value in giving a general picture as to the most probable metabolism of individuals of a given sex, age, weight, and height, and that this probable metabolism cannot adequately be computed until a relatively large number of observations have been made on individuals. Fortunately in recent years a method of studying individuals in groups has been satisfactorily developed in this Laboratory and put to severe tests, and we were therefore in a position to consider studying not only individuals but groups of individuals. This made it possible to attack the whole problem from a different angle.

Entirely aside, however, from the labor involved in individual measurements of children of this age range, came the problem of securing the subjects. In studying girls in the age range of 12 to 17 years we found that institutional children were practically precluded as subjects. Furthermore, we found that the coöperation of the subject and usually of the parents was essential. Most parents will not readily subject their children to the supposed hardship of leaving home early in the morning, without breakfast, to go some distance to a laboratory for purposes of observation. DuBois,[10] in studying his Boy Scouts, had to resort to giving a "small" breakfast, but even under these conditions the boys were studied alone in a respiration chamber, rarely slept, were usually awake, were allowed to read, in many instances were very much bored, and apparently at times restlessness was controlled with difficulty. We foresaw instantly that such an experience would be our lot, did we attempt to study individual girls, with perhaps great difficulty in securing the coöperation of the parents as well as the children for such an observational routine.

A method which will allow the subject to be with a group of individuals and which does not call for any great hardship in the line of deprivation of meals or isolation in strange apparatus, would normally appeal more readily to a group of girls than the regular metabolism technique. In the last analysis individual determinations of basal metabolism are of prime interest in establishing the probable normal or the variations from normal, which may commonly be expected. These variations we have already seen to be rather considerable. No two individuals of the same height, weight, age and sex may be stated to have exactly the same metabolism, and if a group of girls of a given age were studied individually, metabolism measurements of rather considerable variability could normally be expected. Even provided the girls were all selected of the same weight as well as the same age, variations would still exist, and if, as a result of most stringent selection, uniform height were added to these two constant factors, we have reason to believe that even this selection would not rule out a considerable number of individual variations. Consequently the averaging or grouping of results is ultimately necessary in forming a general picture as to the trend of metabolism, based upon either age, height or weight. It is, therefore, not illogical to study a group of individuals in which one factor is approximately constant, such as age, for example, in an apparatus which does not distinguish one individual from another, that is, in an apparatus where the measurements are made *en masse* or by a group system. It is our belief that with children such a method

of study would be even more logical and permissible than with adults. It would not be possible, for example, or justifiable to measure the simultaneous metabolism of 12 adults in which the age factor alone was held constant. Thus, with 12 women of 40 years of age, experience has shown that the weight factor may vary greatly. On the other hand, children "run to form" more regularly than adults, for there are seldom excessively fat children, although the excessively thin child is only too frequent. Indeed, so reasonably regular is the relationship between age and weight that it is common to establish a weight-age curve for children. At present this curve is much used in the attempts to secure better nourished children in schools, although destined, we believe, soon to be superseded by the scientifically more exact weight-height curve.

The study of humans in groups has been satisfactorily carried out and the efficiency of the method thoroughly demonstrated in this Laboratory in at least two researches. In an investigation of several months' duration on the influence of prolonged undernutrition upon basal metabolism[12] two separate groups of students from the International Y. M. C. A. College, Springfield, Mass., were studied while in bed, asleep, in a large respiration chamber at the Nutrition Laboratory. Both groups represented fairly homogeneous material, *i.e.*, the college undergraduate body. The basal metabolism, computed per kilogram of body weight, of these two groups studied *en masse* was identical on successive nights, prior to any dietetic alterations, thus demonstrating that the apparatus gave very uniform results and that a group of 12 selected from fairly homogeneous material was sufficiently large. Even larger groups were studied in this chamber, engaged in light household operations.[13] For instance, as many as 25 young women students at Simmons College, Boston, were studied simultaneously, average values for the several household occupations being secured with rapidity and uniformity from period to period.

To apply this method of studying metabolism in groups to young girls involved no special alteration. Emphasis was laid upon the group or troop idea, and with this in mind our first efforts to secure subjects were made through that highly organized and most successful institution, the Girl Scouts of America, a part of whose creed is the idea of service to humanity in some definite form. By selecting, therefore, groups from the Girl Scouts, many difficulties in the way of administrative responsibility and individual apprehension on the part of both the girls and their parents could be avoided.

The respiration chamber in which the studies on undernutrition and household activities were made determines only carbon dioxide, and the question immediately arose as to whether this determination alone can serve as an index for basal metabolism with a sufficient degree of accuracy to justify the expenditure of time and labor necessary for so extended a series of observations as was originally planned. The oxygen consumption is, on the whole, a much better index of the heat production than is the carbon-dioxide output, but if it is possible to compute (with a fair degree of accuracy) or, better still, determine, as we ultimately did, the respiratory quotient of the group as a whole, the total carbon-dioxide measurement is no longer inferior to the oxygen measurement as an index of the total heat production.

In brief, then, our method was to study groups of girls of constant age, selected from various troops of Girl Scouts. Each group received a light, uniform supper at the Laboratory and engaged in no excessive muscular activity during the evening. The girls slept inside a respiration chamber throughout the night and measurements of the carbon-dioxide production were made while they were in deep sleep. Thus complete muscular repose and control of the factor of food ingestion were insured, and hence the computation of the probable heat production from the carbon-dioxide output could be made with a reasonably small error. If the experimental periods are sufficiently short to enable a repetition of measurements from half hour to half hour or from hour to hour, the minimum values thus found should correspond to the true basal carbon-dioxide production. If the values are affected by muscular activity, certain periods will be much higher than others. If they are affected by differences in the character of the material katabolized, one would normally expect high values for carbon dioxide at the beginning of the night, these values rapidly decreasing and not subsequently increasing throughout the night.

TECHNIQUE.

The respiration chamber in which these observations were carried out has been described in considerable detail in an earlier publication.[12] Its main features* are an air-tight room or chamber, lined with sheet-metal, two windows at one end for light supplemented by electric illumination, a hinged trap door at the top relying for final closure upon a water seal, a pipe supplying uncontaminated outdoor air at one end of the chamber, and a pipe delivering air from the chamber to the aliquoting device. To assist in maintaining comfortable conditions, a brine coil pipe, which could be supplemented by an electric fan blowing over it, made temperature control most satisfactory. The air leaving the chamber contained carbon dioxide produced by the children. This was withdrawn by an electric blower, properly aliquoted, and the carbon dioxide in the aliquot sample was completely removed by driving the sample through bottles containing soda-lime and sulphuric acid, respectively. Duplicate analyses could be satisfactorily made. The accuracy of the apparatus as a whole for determining carbon dioxide has been repeatedly tested by introducing into the chamber accurately weighed amounts of carbon dioxide from a steel cylinder containing the liquefied gas. The subsequent recovery of this gas by means of the aliquoting and carbon-dioxide absorbing device is sufficiently perfect to stamp the apparatus as an instrument of precision.

The air of the room was cool, dry, and kept in motion by an electric fan. The ventilation was only of such a rate as to keep the carbon-dioxide percentage inside the chamber not far from 0.5. While not infrequently subjects complained of the fact that the chamber seemed warm, no complaint of odor, stuffiness or any other disagreeable feature was ever made. It should be stated that many of these children had been trained to sleep on outside sleeping porches, even in winter. It was mechanically impossible to lower the temperature of the respiration chamber to any degree corresponding to this. Usually the temperature of the dry bulb was not far from 18° to 20° C., while that of the wet bulb varied from 10° to 11° C.

The carbon-dioxide production of each group of girls was measured for every half hour or hour period throughout the night.* The respiratory quotient was determined in the following manner: after the minimum carbon-dioxide production per half hour or per hour had been clearly established, which occurred usually not far from 12.30 to 1.30 A.M., *i.e.*, after all the girls were sound asleep, a few periods were then made to insure that the carbon-dioxide production did not decrease further and that the minimum had been reached. On several nights the entire ventilation was stopped from 3.30 A.M. to 4.30 A.M., or 5 A.M., during which time the carbon-dioxide percentage in the air of the chamber, which was normally not far from 0.5 at this hour in the morning, rose to between 0.8 and 0.9. By making a most careful determination with the Sondén apparatus[14] of the carbon-dioxide percentage in the air, as well as of the oxygen percentage, the respiratory quotient could be determined. This method is identically that which was employed in the investigation on under-nutrition[15] in determining the respiratory quotients of subjects inside a treadmill chamber.

As a result of our several determinations of the respiratory quotient we have made all our computations for the heat production of these girls by assuming a calorific value of carbon dioxide amounting to 3.086 calories per gram.

(To be continued.)

CLINICAL OBSERVATION WITH BENEDICT'S NEW PORTABLE RESPIRATION APPARATUS.

BY PAUL ROTH, M.D., BATTLE CREEK, MICH.,

Metabolism Department of the Battle Creek Sanitarium.

THE rapidly spreading interest shown by clinicians in the estimation of the basal metabolic rate as a diagnostic and therapeutic guide in medicine and surgery is primarily the result of many years of patient and painstaking research. Studies have been made with most elaborate and intricate, as well as costly apparatus of various kinds for the sole and fundamental purpose of establishing the normal standards, without which even the most accurate

* This principle has been applied to the study of the carbon-dioxide production of large domestic animals in the Agricultural Experiment Station, Durham, N. H. See Benedict, Collins, Hendry, and Johnson: "A Respiration Chamber for Large Domestic Animals," Technical Bulletin No. 16, 1920, New Hampshire Agricultural Experiment Station.

* It is a great pleasure to acknowledge the faithful and invaluable assistance in these tedious night observations of Miss Marion L. Baker, without whose skillful aid the research could hardly have been completed.

determination of the metabolic rate would be useless to the clinician. Without those and other physiological standards, there can be no meaning in mere figures relative to the quantitative or qualitative measurements of any body function.

If the measurement of the rate of function of individual organs or systems is indispensable in clinical work, one would most naturally expect that the measure of the sum-total of body energy output, in other words, the measure of the metabolic rate, should prove to be of inestimable value.

There are today a large number of functional measurements which, in spite of their importance, have never entered the field of clinical practice because many such measurements are simply impossible outside the research laboratory. While we admire the great ingenuity that has been exhibited in contriving devices of the most intricate nature to meet the demands of the complex problems which had to be faced to establish reliable normal metabolic rate standards, the efforts made to simplify ways and means, thus placing within the reach of the clinician an invaluable diagnostic and therapeutic guide, deserve our respectful recognition.

We are deeply indebted to Dr. F. G. Benedict, director of the Nutrition Laboratory of the Carnegie Institution, who, through his personal help and the coöperation of members of his staff enabled the writer to establish, in 1913, at the Battle Creek Institution, the first laboratory for the clinical study of basal metabolism.

At that time the activities of this department were largely confined to the management of diabetes, hyperthyroidism and obesity. In its early days the laboratory also collaborated in the study of "The Basal Metabolism of Normal Men and Women."[1]

The apparatus used was the "Benedict Universal Respiration Apparatus,"[2] devised over ten years ago. Until that time the determination of body metabolism required, even in the simpler methods, an analysis of the expired air. This was a serious obstacle to the introduction of the methods in clinical work, because of this comparatively difficult step which at best requires a well-trained analyst. It was to eliminate entirely the need of air analysis that Benedict devised his first respiration apparatus.

This proved successful and encouraged the inventor to further attempts to devise an apparatus which would be simple in operation and easily transported to the bedside. This "transportable" respiration apparatus is fully described and discussed in the literature referred to below.[3]

Seven of these were first built at the Nutrition Laboratory of the Carnegie Institution, and were part of an elaborate outfit gathered at this laboratory and sent out with a corps of workers to the Y. M. C. A. College at Springfield, Massachusetts, in the fall of 1917, where they were in daily use for over four months in the study of "Human Vitality and Efficiency under Prolonged Restricted Diet."[4]

Having taken an active part in this research both in Boston and Springfield, Massachusetts, under the direction of Dr. Benedict, I not only became thoroughly acquainted with the use of this apparatus but obtained a thorough personal experience in the technic involved in the "Respiratory Valve Method," the so-called "Tissot" method, with which also daily observations were made.

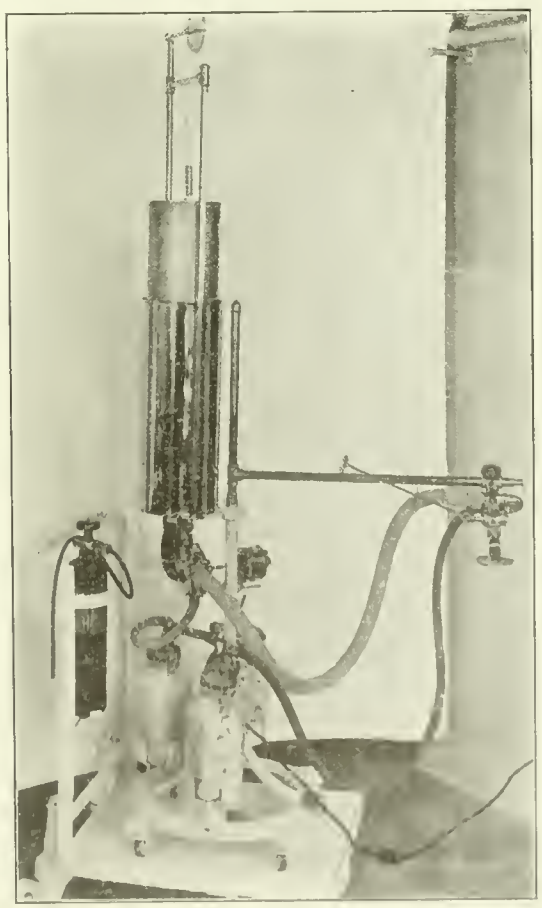

Fig. 1.

Upon the completion of this work one of the Benedict apparatus was purchased and added to our equipment at the Battle Creek Sanitarium. Later the rapidly growing needs required the addition of three more apparatus of the same type.* One of them was placed on a small truck to make it easily transportable (Fig. 1).

Realizing the specific advantages of a more elaborate equipment which would enable us to resume various lines of research work interrupted by the war, and also in order to study more specifically those cases in which the determination of the respiratory quotient is important, we introduced, at a considerable expense the "Tissot" method[5] with a battery of Haldane Air Analysis Apparatus and two gasometers.[6]

This phase of the work was placed under the supervision of Miss Anna C. Peterson, M.S., a skillful technician, under whose direction additional air analysts were trained.

I have had an unusual opportunity to compare from all standpoints the clinical merits of the methods and apparatus mentioned. On account of its simplicity, greater ease of operation and the remarkably satisfactory results, I consider Benedict's respiration apparatus one of the most valuable contributions of recent years to the armamentarium of the clinician.

This is merely touching the salient points in my personal observations relative to this most important subject. Those interested will, no doubt, appreciate further valuable modifications which have recently been made by Benedict in his apparatus.[7] It is now not only truly "portable" but also the chances of leakage have been almost entirely eliminated and its up-keep much simplified, all of which has been attained without any sacrifice of accuracy.

The clinician must often, of necessity, apply methods and use apparatus of all kinds merely on their reputation. Benedict is recognized as the highest authority on methods, apparatus, and technic in the study of metabolism. He emphatically states that "the portable will always be an *empirical* apparatus," and "distinctly a *clinical* apparatus." He and others have, nevertheless, demonstrated in its use, a degree of accuracy which, in the work for which it is intended, is equal to that obtained with other more intricate methods and apparatus. A satisfactory technic for its use can be mastered in one hour's time by an intelligent high-school graduate, or the equivalent. At my request a young woman who had just joined the laboratory force and who had never before seen the apparatus, was given less than a half hour's instruction in the technic of the use of the apparatus, following which she made a successful determination, using her instructor as a subject.

I do not wish to give the impression that further careful technical training is not essential, but I maintain that the ability required to make with it a successful estimation of the metabolic rate, is well within the reach of an individual who has any right to the position of doctor's or laboratory assistant. In weighing the chances of error, for they will occur in spite of the most careful technic, I am convinced that they lie much more in the improper management of the subject examined than in the handling of the apparatus. Tact, irrespective of the method used, and good judgment, are of the utmost importance with sick individuals. In rare cases success is an impossibility because the necessary coöperation of the patient cannot be obtained. Not infrequently a second test a day or two later will prove very successful when the first failed. A tactful and observing technician usually succeeds from the start where an indifferent, machine-like, though otherwise perfect operator fails, and failures of this sort should not be attributed to the method. The test is for the determination of the *basal* metabolic rate and not the metabolic rate as influenced by apprehension, fear, fatigue, impatience, indignation (the result, perhaps, of long waiting one's turn in the physician's office), the tickling of a fly, discomfort, pain, or anything which increases muscular tension.

I had the opportunity to use and thoroughly test an apparatus of this new type, constructed under the direction of Dr. Benedict by Mr. W. E. Collins, mechanician of the Nutrition Laboratory.* The apparatus was unpacked and set up by a university student who had had no experience in our metabolism department. Miss S. L. Cole of the department made most of the 48 observations reported in Table I.

While the apparatus was not entirely entrusted to inexperienced hands, it received from our laboratory staff only the intelligent man-

* From the Sanborn Company, Boston, Mass.

* I am informed that the apparatus is now obtainable from Warren E. Collins, 584 Huntington Ave., Boston 17, Mass.

TABLE I.—BASAL METABOLISM, DETERMINED WITH BENEDICT'S NEW PORTABLE RESPIRATION APPARATUS.

SERIES OF FORTY-EIGHT OBSERVATIONS ON UNSELECTED, CONSECUTIVE CLINICAL CASES.

No	Sex Age	Weight kg.	Height cm.	Test	Time (Min)	Pulse	Avge	Resp.	Avge	O_2 per min. c c	Avge	Basal Metab. Rate	Avge	Observations Of Operator	DIAGNOSIS Clinical Findings Suggesting Faulty Metabolism
1	F 25	55.4	166	A	13.03	90		22		215		-4			AUTO-INTOXICATION
				B	10.35	91		20		214		-4			Nervous Exhaustion.
						91	91	20	21		215		-4	None	
2	F 48	42.7	164	A	5.98	86		17		209		+17			CHRONIC FOLLICULAR TONSILLITIS,
				B	3.92	86		17		220		+24		Became excited	ALVEOLAR ABSCESS
							86		17				+21	Period cutshort	Neurasthenia with Apprehension
3	F 53	53.2	170.5	A	13.07	101		16		225		+15			CHRONIC FOLLICULAR TONSILLITIS,
				B	10.12	97		15		221		+14			SECONDARY ANEMIA, CARDIAC
						99	99		15		223		+15	Very Nervous.	HYPERTHROPHY (SLIGHT)
4	M 45	44.4	165½	A	15.20	58		15		194		+0			
				B	8.22	58		15		191		-2			
						57	58		15		193		-1	Mr. B. Very	
5	M 45	44.2	165½	A	13.22	54		23		193		-1		difficult case	
				B	10.70	59		19		191		-2		to handle in	HYPOTHYROIDISM:
						47	50		21		192		-1	every respect.	Asthenia, Symptoms of Hysteria.
6	M 45	43.2	165½	A	13.12	54		24		224		+17		*	
				B	10.68	55		26		227		+18			
						55	55	26	25		226		+18		
7	M 45	42.95	165½	A	12.37	56		19		187		-2			
				B	9.60	56		16		187		-2			
						59	58	20	19		187		-2		
8	M 45	42.5	165½	A	11.58	50		21		155		-17			
				B	9.38	50		20		158		-18			
							50		21		157		-16		
9	M 45	43.0	165½	A	12.42	55		18		189		-1			
				B	9.88	58		20		185		-4			
							57		19		187		-2		
10	F 54	62.5	163	A	13.27	53		12		170		-15			CHRONIC MYOCARDITIS WITH MITRAL
				B	10.43	52		14		171		-15			INSUFFICIENCY; Insomnia, Neurotic
						51	52	15	14		171		-15	None	Temperament.

No	Sex Age	Weight kg.	Height cm.	Test	Time (Min)	Pulse	Avge	Resp.	Avge	O_2 per min. c c.	Avge	Basal Metab. Rate	Avge	Observations Of Operator	DIAGNOSIS Clinical Findings Suggesting Faulty Metabolism
11	F 45	56.4	154½	A	12.90	73		16		154		-20			LUES, CONSTIPATION;
				B	10.03	73		17		156		-19			Nervousness, Insomnia.
						72	73		17		155		-19	None	
12	F 54	63.2	159½	A	13.32	81		21		213		+10			ANGIO-NEUROTIC EDEMA, MIGRAINE
				B	10.60	83		18		220		+13			
						82	82	18	19		217		+12	None	
13	M 14	46.2	155.5	A	9.43	75		18		253		+10			TESTICULAR HORMONE INSUFFICIENCY
				B	6.75	76		19		251		+ 9			
							76		17		252		+9	None	
14	M 54	59.5	172	A	13.17	59		17		240		+9			PSORIASIS, CHRONIC OSTEOARTHRITIS,
				B	10.33	54		18		226		+3			CHRONIC TONSILLITIS, ALVEOLAR ABSCESS.
						61	56		18		233		+6	Very Nervous	
15	F 44	44.5	163.5	A	13.15	90		15		200		+11			
				B	10.87	82		15		192		+ 7			
						82	85	15	15		195		+9	None	Enlarged Thyroid.
16	M 56	75.9	187½	A	9.17	68		14		341		+31			
				B	6.42	67		14		324		+25			DIABETES MELLITUS, HYPERTHYROIDISM,
						69	68		14		333		+28	None	CARDIAC HYPERTROPHY.
17	M 45	60.5	170½	A	11.82	64		16		268		+19			
				B	9.13	63		16		271		+20			
							64		16		270		+19	Restless Moved	TERTIARY LUES, CHRONIC ALCOHOLISM,
18	M 38	68.3	169	A	11.95	70		20		264		+5			CHRONIC CARDIAC VALVULAR DISEASE-MITRAL
				B	9.37	69		20		259		+6			INSUFFICIENCY. CHRONIC POISONING BY
						68	69		20		266		+7	None	NICOTINE.
19	F 16	42.7	146½	A	10.38	119		24		262		+44			
				B	7.97	115		23		265		+45			
						116	117	30	26		263		+45	None	EXOPHTHALMIC GOITRE.
															ARTERIOSCLEROSIS, CHRONIC FOLLICULAR
															TONSILLITIS.

No	Sex Age	Weight kg.	Height cm.	Test	Time (Min)	Pulse	Avge	Resp.	Avge	O_2 per min. c c	Avge	Basal Metab. Rate	Avge	Observations Of Operator	DIAGNOSIS Clinical Findings Suggesting Faulty Metabolism
20	F 52	58.2	160	A	13.17	72		22		197		+2			ARTERIOSCLEROSIS, CHRONIC FOLLICULAR
				B	9.95	68		19		196		+3			TONSILLITIS.
						72	71		21		198		+2	None	
21	M 30	54.6	170.5	A	11.95	61		12		215		-4			
				B	10.00	61		12		214		-4			
						60	61	13	12		215		-4	None	Neurasthenia.
22	M 37	56.8	171.5	A	12.67	72		16		213		-6			
				B	9.93	91		14		206		-9			
						73	72		15		210		-7	None	MYOCARDITIS, HYPERTHYROIDISM.
23	F 54	60.5	163½	A	13.53	75		11		179		-10			
				B	10.35	67		8		175		12			
							71		10		178		-11	None	PERNICIOUS ANEMIA WITH CORD
24	M 30	56.8	182	A	8.67	71		16		240		+10		Very Nervous	REGENERATION.
				B	6.20			16		226		+ 4		at times	CHRONIC ARTHRITIS; Neurasthenia.
							71		16		233		+7		
25	M 22	56.4	164	A	12.58	90		14		217		+ 5		More relaxed	
				B	10.07	86		16		206		+ 1		toward end.	Enlarged Thyroid
						81	86		15		212		+3		
26	F 52	48.2	161½	A	12.68	1111		15		219		+21			
				B	10.10	107		15		219		+21			HYPERTHYROIDISM, CHRONIC MUCOUS
						107	108	15	15		219		+21	None	COLITIS.
27	F 53	63.2	163	A	11.18	90		19		264		+26			
				B	8.63	89		18		263		+26			MENOPAUSE; General Debility,
						94	91		19		264		+26	None	Following operation.
28	F 29	99.6	161	A	13.58	59		17		253		-2			OBESITY; Enlarged Thyroid, Hypotensic
				B	10.42	58		16		250		-4			
						59	59	18	17		252		-3	Moved Hands	

The fluctuation shown in the case of Mr. B. is due to the therapeutic effects of thyroid extract. The correct dose to maintain his metabolic rate within the normal was readily established by a few tests. In this case one grain of the extract three times daily was found to be required.

TABLE I. (*continued*)

No	Sex Age	Weight Kg.	Height Cm.	Test	Time (Min)	Pulse Avge	Resp. Avge	O_2 per min c.c. Avge		Basal Metab. Rate	Basal Metab. Avge.	Observations of Operator	DIAGNOSIS Clinical Findings Suggesting Faulty Metabolism
29	W31	41.8	158¼	A B	13.38 10.68	111 109 117 112	20 20 20	261 246	250	+48 +44	+44	Moved Hands	HYPERTHYROIDISM
30	W38	64.2	168.5	A B	12.75 10.15	72 70 71 71	14 15 15	188 190	189	-13 -14	-13	None	MIGRAINE, CHRONIC CONSTIPATION
31	W35	65.7	156¼	A B	10.62 7.98	60 61 58 60	19 19 19 19	202 190	196	-3 -9	-6	Suffering-could not keep still.	CHRONIC TONSILLITIS, ALVEOLAR ABSCESS CHRONIC OSTEOARTHRITIS; Neurasthenia.
32	W26	50	167.5	A B	10.98 8.23	96 94 93	16 15 16 16	222 219	221	+12 +11	+11	Excited Frightened	CHRONIC COLITIS Nervous Irritability.
33	W48	56.2	163¼	A B	13.53 10.73	112 116 112 113	14 14 14	261 258	260	+31 +30	+30	None	HYPERTHYROIDISM, ALVEOLAR ABSCESSES
34	W37	76.1	173-1/4	A B	13.70 9.63	69 70 70 70	17 17 17 17	231 238	235	-11 -8	-8	None	ASTHMA
35	W16	70.9	156¼	A B	11.43 8.92	69 70 70 69	17 17 17	222 219	221	-1 -2	-2	None	MANIC DEPRESSIVE PSYCHOSIS
36	W48	61.6	162	A B	12.58 9.18	69 71 68 70	14 18 16	186 182	184	-9 -11	-10	None	CHRONIC NEPHRITIS
37	W40	76.4	169	A B	13.58 10.15	74 76 79 76	18 17 18	224 224	224	-6 -4	-4	Moved Hands	HYPERTENSION, CHRONIC ENDOMETRITIS
38	W46	46.6	170¼	A B	11.70 8.98	72 71 68 70	18 19 19	166 162	174	-10 -21	-16	Very irregular breathing	DIABETES MELLITUS, CHRONIC TONSILLITIS, ALVEOLAR ABSCESSES, PYORRHEA, HEALED FIBROTIC TUBERCULOSIS

No	Sex Age	Weight Kg.	Height Cm.	Test	Time (Min)	Pulse Avge	Resp. Avge	O_2 per min c.c. Avge		Basal Metab. Rate	Basal Metab. Avge.	Observations of Operator	DIAGNOSIS Clinical Findings Suggesting Faulty Metabolism
39	F 35	63.0	167	A B	14.08 10.68	85 79 80 81	19 18 19	254 265	.258	+16 +19	+19	None	GENERAL LYMPHADENITIS, MIGRAINE
40	F 60	63.7	157	A B	11.62 9.07	92 88 85	12 12 12	199 203	201	+0 +3	+1	Seemed Nervous	CHRONIC FOLLICULAR TONSILLITIS, CHRONIC MUCOUS COLITIS Nerve Exhaustion.
41	F 42	110	167	A B	9.67 7.16	68 66 67	16 18 18	268 278	272	+1 +3	+1	None	OBESITY.
42	F 40	49.8	168	A B	12.70 10.03	67 64 65 66	24 17 16 18	199 198	198	+3 +3	+3	Moved Feet "Tiresome"	Positive Goetsch Test.
43	M 50	69.1	171¼	A B	13.63 10.90	60 60 61 60	11 10 11	235 234	235	+1 +1	+1	None	CHRONIC TONSILLITIS, ALVEOLAR ABSCESS; R. Lobe Thyroid Enlarged.
44	F 54	60.2	165.0	A B	13.95 11.20	73 71 73 72	14 14 14	182 183	183	-9 -9	-9	None	PAROXYSMAL TACHYCARDIA, NEURITIS, 8TH NERVE DEAFNESS, AUTO-INTOXICATION
45	F 61	47.4	148	A B	8.62 4.20	82 76 79		240 248	244	+52 +49	+49	Very Nervous	MIGRAINE; Nervous Asthenia
46	F 38	39.8	159¼	A	12.78 10.03	75 75 74 74	20 21 21 21	164 167	166	-4 -2	-3	None	PROBABLE CHRONIC CHOLECYSTITIS, CHRONIC CARDIAC DILATATION.
47	F 33	64.8	161¼	A B	10.98 8.33	80 79 80	16 17 18 17	238 224	231	+12 +6	+9	None	CHRONIC ENDOCARDITIS, CHRONIC MYOCARDITIS, SECONDARY ANEMIA (mild)
48	F 27	78.8	165	A B	14.10 11.16	92 88 89 90	12 14 13	239 239	239	+8 +8	+8	None	CHRONIC CARDIAC DILATATION, HYPOPITUITARISM.

ning which this class of work, as any clinical work, demands.

This series includes sick individuals of all types, all new, unselected and untrained subjects. A number of them were anything but easy to manage and yet not one of the tests can be regarded as a complete failure, although periods A and B do not always check up closely.

The trial soon proved to be a success. Indeed the results were so satisfactory that when, unfortunately the apparatus was accidentally upset necessitating repairs, I modified, to replace it, one of the older models, housing both air impeller and soda lime absorber *inside* the spirometer, without discarding, however, the three-way valve. At present these apparatus are in constant use, both giving equally satisfactory results.

This modified apparatus (Fig. 2) is in fact a faithful duplicate of the original one from Dr. Benedict, except that the retained base and mountings do not make of it a truly portable apparatus. This feature is essential only, of course, for bedside observations. The soda-lime absorber and electric air impeller have been taken out and are shown in their relative position when in place inside the spirometer.*

This apparatus was used in the next series of observations made with normal trained and untrained subjects. For lack of space, results with only one trained and one untrained subject are reported in Tables II and III and show most admirably the high grade of work made possible with its use.

The technic followed is that described by

* For directions and assistance to make these alterations in the older type of apparatus, write to W. E. Collins, 581 Huntington Ave., Boston 17, Mass.

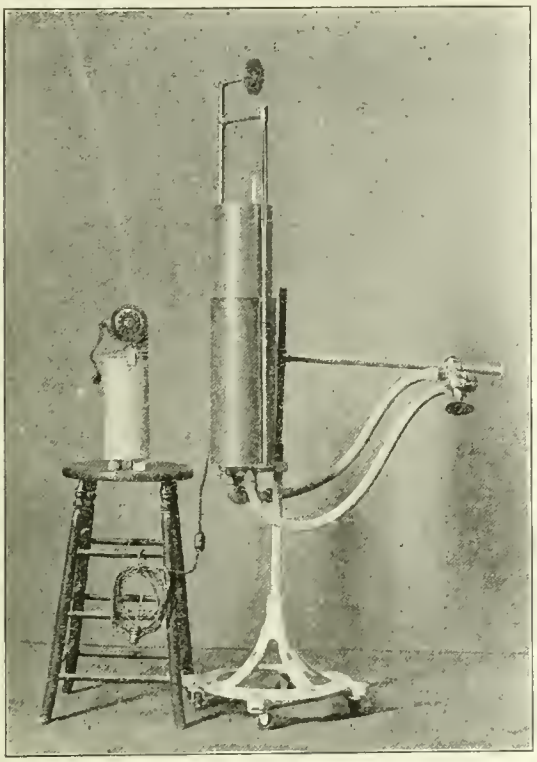

FIG. 2.

Benedict.[3, 7] Being well supplied with stop-watches they were used for timing the periods. I have used an ordinary watch many times with this and other forms of apparatus and know that if need be it will answer the purpose very nicely.

The fact should not be ignored that, if not properly regulated, a stop watch may register incorrect time. When two or more are used they should at least be compared by starting and stopping them simultaneously. They should not vary more than one or two seconds in a 10-15 minute period.

A more serious mistake of a whole minute will readily be made if the "*minute* recording hand" of a stop-watch happens to be inaccurately set. The two hands being superimposed at the starting position, the covered minute recording hand can be as much as one minute off, one way or the other, without it being noticed. Even if this is discovered at the start, a correct final reading can readily become somewhat uncertain.

In Table I, period A was timed first and last, while period B was taken *within* the interval of period A. The readings were taken by Emmes' method in both. This method of running one or more checking periods within a longer one was introduced early in the use of the apparatus in order to compare the one period method as originally run, with one or two shorter periods taken during the same interval by Emmes' method.[3] There seemed to be no reason for a change in our routine even after Emmes' method was adopted exclusively, but recent observations show that *better results are obtained from the average of two or three overlapping*

TABLE II.—BASAL METABOLISM, DETERMINED WITH BENEDICT'S NEW PORTABLE APPARATUS.

N. O. B. Normal Trained Subject. Male, age 39; weight, 60.5 kg.; height, 169 cm.

July, 1920	Test Period	Duration in Min. and Hundredths	Pulse	Respiration	O_2 per Min. C.c.	Metabolic Rate Percent of Harris-Benedict Predicted Normal
13	A	12.57	68, 68, 69	18, 15, 18	230	
	B	9.60			223	
	Avgs		68	16	227	+5
14	A	13.03	66, 67, 68	15, 16, 18,	216	
	B	10.03			218	
	Avgs		66	17	217	+2
15	A	13.78	59, 60, 64,	15, 16, 15	218	
	B	10.33	61		216	
	Avgs		61	15	217	+2
16	A	12.28	62, 66, 67,	11, 14, 15,	224	
	B	10.02			217	
	Avgs		64	13	221	+4
18	A	12.93	64, 64, 66	16, 16, 17	2.0	
	B	10.32			218	
	Avgs		65	16	219	+3
23	A	13.72	67, 65, 66	18, 16, 20	217	
	B	11.30			218	
	Avgs		66	17	218	+3
27	A	15.17	66, 65, 65,	14, 13, 15,	222	
	B	17.83	64, 65,	13, 14,	230	
	C	15.47	63, 62, 64,	14, 13, 14,	224	
	D	13.72	65, 66, 63,	13.	221	
	Avgs		65	14	222	+4
28	A	14.88	68, 68, 70,	14, 14, 15,	216	
	B	13.27	65, 65,	15,	215	
	C	14.98	66, 65, 65,	15, 13, 14,	216	
	D	11.25	64, 67,	14.	215	
	Avgs		66	14	216	+1
29	A	17.83	67, 66, 68,	13, 13, 14,	227	
	B	14.15	66, 68	13, 13.	224	
	C	14.08	67, 67, 69,	13, 13, 14,	231	
	D	12.05	68.	14.	227	
	Avgs		67	13	227	+6
30	A	13.68	65, 64, 65,	13, 13, 13,	215	
	B	11.67	64,	14.	212	
	C	15.60	64, 64, 64,	15, 14, 15,	217	
	D	13.16	65, 65.	15.	215	
	Avgs		64	14	215	+1
Aug. 1920 2	A	13.83	59, 60, 60,	12, 12, 13,	219	
	B	11.87	59.		220	
	C	15.32	61, 61, 60,	13, 12, 13,	222	
	D	13.12	62, 60	13, 13.	221	
	Avgs		60	13	221	+4
2	A	13.60	61, 62, 62,	13, 13, 12,	229	
	B	11.08	62.	12,	215	
	C	15.12	65, 62, 61,	13, 13, 12	225	
	D	12.77	64, 63, 63.		225	
	Avgs		63	13	221	+4
3	A	14.28	64, 65, 63,	14, 15, 15,	217	
	B	12.37	64.		220	
	C	14.48	63, 65, 64,	15, 14, 14,	222	
	D	12.10	64.	15.	221	
	Avgs		64	14	220	+3
4	1	10.00	65	14	a 228	+5
	2	10.00	64	14	a 220	+3
5	A	12.37	65, 65, 66,	13, 13, 14,	211	
	B	11.43	67, 65.	12.	211	
	C	11.26	66, 66, 68,	14, 14, 14,	215	
	D	12.40	68, 66.		219	
	Avgs		66	14	213	0
6	A	13.00	65, 65, 65	14, 14, 15.	214	
	B	11.08			214	
	C	12.13	67, 66, 65.	14, 14, 13	a 222	
	D	10.40			a a 233	
	Avgs		65	14	216	+3
9	A	13.09	63, 65, 64,	16, 14, 13,	210	
	B	10.60	63, 70	15, 16.	211	
	C	14.05	66, 66, 66	15, 13, 16.	214	
	D	11.42			213	
	Avgs		67	16	212	-1
10	A	12.78	66, 66, 66,	13, 15, 14,	208	
	B	10.43	65,	13.	203	
	C	14.17	67, 66, 64,	13, 14.	210	
	D	12.73	66, 65.		208	
	E	6.00			206	
	Avgs		66	14	208	-2
12	A	12.43	62, 64, 60,	13, 13, 12,	208	
	B	11.68	64, 64.	14, 14.	209	
	C	11.80	62, 63, 62,	14, 14, 14,	208	
	D	13.30	63, 63, 61.	14, 13, 14.	214	
	Avgs		63	14	210	-4

August 4, the Basal Metabolism was estimated with the Respiratory Valve (Tissot) Method by Miss Anna C. Peterson, who observed a like close agreement between the two methods in many comparison tests made recently.

short periods uniformly timed in close succession and with the spirometer bell operating within fairly uniform levels of travel.

TABLE III.—BASAL METABOLISM, DETERMINED WITH BENEDICT'S NEW PORTABLE APPARATUS.

J. L. B. Normal Untrained Subject. Male; age, 33; weight, 49.4 kg.; height, 167.5 cm.

Aug. 1920	Period	Duration In Min. and Hundredths	Pulse	Respiration	O_2 per Min. C.C.	Metabolic Rate Percent of Harris-Benedict Predicted Normal
23	A	11.28	59, 58, 59	12, 11, 11, 11	193	
	B	10.88			195	
	C	10.17			198	
	D	10.07			199	
	Avge		59	11	196	0
11	A	10.15	58, 58, 58	11, 11,	194	
	B	10.47			197	
	C	10.35			195	
	D	10.35			196	
	Avge		58	11	195	0
30	A	10.77	56, 55, 54	14, 15, 14	200	
	B	10.65			198	
	C	10.53			202	
	D	9.62			203	
	Avge		55	14	201	+ 3
11	A	10.50	56, 56, 56	15, 15, 15	192	
	B	10.75			190	
	C	11.40			190	
	D	11.48			191	
	Avge		56	15	191	-2

The subject remarked after the test that he was lying on a bunch of keys in his hip pocket and thus became uncomfortable toward the end of the period. This explains the high results in periods C and D.

A FEW SUGGESTIONS.

A careful study of the literature referred to in this paper will save much time and trouble for those who undertake the estimation of basal metabolism. The ounce of prevention lies mostly in stepping along intelligently. The apparatus as now modified requires little attention. The chief points to observe are the following:

Test the apparatus daily for possible leakage. If carefully put together a leak may never occur.

The operator should breathe into the apparatus occasionally to assure himself that the circulation of air is unobstructed and the breathing free and easy. The chief causes of obstruction are, (a) too large a quantity of soda-lime in the container, especially when it is too fine and powdery, or when it is allowed to cake. If fine soda-lime is used the container should be only partially filled. The absorber should occasionally be removed from the apparatus, tilted and shaken to prevent the soda-lime from caking; (b) the rubber tubing may be too small or more or less kinked; (c) water, either spilled over from the apparatus, or a result of condensation of moisture in the expired air, may easily occlude dependent loops of the tubing; (d) the air moistener in the mouthpiece assembly unless carefully made, may seriously obstruct the passage of air. I have discarded it without any noticeable inconvenience to the patient.

Accuracy in the volumetric estimation of the oxygen consumption demands that the spirometer readings be taken with a relatively constant amount of CO_2 and of moisture in circulation in the apparatus at the start and at the end of the test period. This is satisfactorily insured if the air impeller is run for a few minutes before the test as directed by Benedict, and if also the first reading is not taken until after the subject has breathed into the apparatus for one or two minutes. Occasionally the respiration of the subject is so irregular that it is difficult to take a reading, and accuracy demands that all the reading should be taken with the lungs in a uniform degree of expansion. It is a physiological fact, well confirmed by hundreds of kymographic tracings taken with this type of apparatus, that *the status of the lungs is more constant at the end of expiration than at the end of inspiration, especially when the subject is unconscious of his breathing.* These tracings further show this to be invariably true when the respiratory movements are irregular. Even in extreme cases surprisingly close agreement between successive estimations are obtained when the average of three periods carefully "picked out" are taken in one test.

Variations of temperature call for a correction in the computations which is easily made, but which is intended for short periods of observation only.

As stated before, the spirometer bell should move within fairly uniform levels of travel. In fact, the *duration of a period should be gauged rather by the distance the bell has fallen than by the watch.* A fall of 120 or 130 mm. for each period is about the right measure.

a. Recent private communications from Dr. Benedict not only confirm this statement but suggest the following:

The present size of spirometer is larger than necessary for ordinary rest observations. Rather than to fill it and to work with the bell high up in the air it is preferable to start with the spirometer not much more than half-full. This works to advantage in two ways: first, it keeps down the large amount of air subject to temperature and pressure changes, and second, it makes it possible to keep the level of water in the spirometer much lower (12 cm. below the top is recommended), and does away with the danger of slopping water over onto the blower and motor.

The efficiency of the soda lime is to be considered. There are simple ways to detect the presence of unabsorbed CO_2 in the air after it has passed through the soda lime absorber, due to the loss of the lime's absorptive power, or this may be indicated also by the resulting noticeable change in the respiration of the subject. When this takes place it means the actual loss of the test period. The safest way is to change the soda lime after every 30 periods, as Benedict suggests, although he states that a container filled with very good soda lime will last for nearly 50 periods, absorbing approximately 200 gm of CO_2.

It has been our custom in using Benedict's Universal Respiration Apparatus to remove the mouth-piece assembly and to sterilize it by boiling it after use in each case. This precaution to guard against any possible transmission of infection from one subject to the next, has seemed to be sufficient. Recently, Dr. G. M. Dobbin, our bacteriologist, has made a careful study of this question, the full results of which will be published when completed. Many cultures have been made from the mouth-piece and parts which are sterilized before being used, and also from adjacent parts which are never sterilized, and which had been breathed into for months by patients of all kinds. Water of condensation from these parts was also used for cultures.

So far the only organism grown in cultures thus made, was the common air-borne, non-pathogenic, harmless B. Subtilis, and even this only from parts that are never sterilized. The water of condensation from the rubber tubing which had been in use for a long time, proved to be sterile.

Cultures were made also from the mouth-piece and valve after the subject had indulged in as much coughing as is likely to occur during a test, also with negative results.

It is evident that the chances of conveying infection from one subject to another, are very remote and practically impossible when simple precautions are taken.

b. Benedict's spirometer is admirably adapted for the *measurement of vital capacity* which is just now receiving special attention owing to the very interesting work of Dreyer of Oxford. He points to its significance particularly of pulmonary tuberculosis.

CALCULATIONS.

The calculations are considerably simplified by the use of the following tables:*

1. Table converting temperature from Farenheit into Centigrade readings, from 60° to 110° F.; and, *vice versa,* from 1° to 15° Centigrade.

2. Table of equivalent of seconds in decimal parts of a minute.

3. Table for converting inches to centimeters.

4. Tables for converting pounds into kilograms.

5. (a) A set of six tables giving, "Factors for Reducing Volume of Gases to Zero degrees Centigrade and 760 mm." (From 12° to 40° Centigrade, and from 710 to 770 mm.

5. (b) For those who prefer to calculate with logarithms, a similar set of tables are made, giving the "log. factor" instead of the "factor."†

6. A blank arranged for systematically recording the clinical data and for calculations is necessary. This will of course vary according to the calculation method chosen. Our department will be glad to furnish on request samples of the blanks used in our laboratory. These may serve as a guide for the drafting of a blanket to meet personal needs.

STANDARDS.

For men and women from the age of 20 and above, we now use the "Standard Multiple Prediction Tables for Normal Basal Metabolism,"[8] without any doubt the most accurate standards available, they enable one to find by the simple addition of two numbers from the tables, what the average normal basal metabolism of any individual should be, in terms of calories for twenty-four hours.

For other ages consult nine and ten of the references.

The reader will find below a number of references to the estimation of basal metabolism in clinical medicine.

For valuable assistance in the perusal of the literature and in the compilation of the bibli-

* In answer to numerous requests, photographic copies of Tables 1 to 5 inclusive, have been compiled by the writer and Miss Anna C. Peterson. These can be obtained either singly or in a complete set, assembled in a loose-leaf binder, from the Photographic Department of the Battle Creek Sanitarium. See above "Calculations" and state in ordering whether 5a or 5b is wanted.

† Just announced: "Tables, Factors, and Formulas for Computing Respiratory Exchange and Biological Transformations of Energy." Carpenter, Pub. 303 Carnegie Institution of Washington, 1921. (In press.)

ography given below I am indebted to Mrs. Lilian Davis, Medical Librarian.

RÉSUMÉ.

1. Benedict's New Portable Respiration Apparatus gives most satisfactory results in its use for the estimation of the Basal Metabolic Rate, and of Vital Capacity.

2. Its adaptability and reliability are demonstrated by series of observations on a large number of unselected, clinical cases of all types, as well as on both trained and untrained subjects.

3. Comparisons with more elaborate methods emphasize its simplicity and practicability in clinical work.

4. Suggestions and information relative to technic, calculations, standards, and bibliography are offered.

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SIDEPATHS IN MEDICINE.*

BY JAY PERKINS, M.D., PROVIDENCE, R. I.

WHEN I was a boy in school, one of the reading lessons was that of some people who, traveling along a main highway, saw an alluring sidepath. They entered it, found it very pleasant, and dallied along until late in the afternoon a heavy thunderstorm came on, followed by darkness. They were lost and spent a terrible night in the woods.

Recently I read a review of a book which narrated the departure of another group from the main civilization into the outland. They, too, found it pleasant, kept going further and further, keeping track of their way by beds of flowers. They, however, were gone for some time, long enough so that the flowers changed with the season, and when they tried to find their way back, the marks had been obliterated, and they, too, were lost. They, however, had found the new country so beautiful and satisfying that they were content to remain there, and gave up seeking to find the way out.

In medicine we have the straight road traveled for centuries; we have the established modes and lines of thought, and he who travels within these limits is safe, and many are satisfied. There are, however, from this main road of established routine many sidepaths and many outlands. In fact, all the specialties are, or have been, sidepaths, and beyond the former realm of medicine. The Hippocratic oath forbade certain lines of surgery. Now, even surgery has its sidepaths, as abdominal surgery and brain surgery. The familiar specialties, the eye, ear, nose, and throat, obstetrics and the others, are sidepaths used but comparatively recently, but now are well-worn, and considered as main roads. There are numerous other sidepaths; some may lead into swamps, some into briar patches, some into woods, but, until we travel them, we do not know but that these, too, may lead into fertile fields. For instance, bacteriology; I can remember while I was a student, there were many who questioned germs being the cause of disease. I was one of the two students who first took bacteriology as an

* Read before the Providence Clinical Club.

elective course counting on a degree in the Harvard Medical School. Bacteriology was then a comparatively little used sidepath. Now it is a main dependence in the practice of medicine. When I entered the Rhode Island Hospital, I brought the first oil immersion lens that was ever at the hospital. The only laboratory was a little room, at one time a part of the dispensary. Now it would be hard to carry on the work of the hospital without its laboratory.

The x-ray is another more recent sidepath, the value of which we do not yet know. In both of these, bacteriology and the x-ray, some things which were formerly shrouded in darkness were made clear, and because of these successes, great hope and reliance were placed upon them, much greater than later developments have justified.

The same is true in reference to blood examinations and physiological chemistry, especially as relating to work of the stomach. All of these things are of great assistance, and have helped to put medical work on a more solid foundation; but even at that, they have not been an unmixed blessing. They have caused us to depend too much upon these objective evidences of health and disease, and to neglect too much careful observation of clinical symptoms, and have made the practice of medicine too much the exercise of scientific formulae and too little of human thought.

There are other sidepaths not in such good repute, as Homeopathy, Christian Science, and Osteopathy. Some of these lead into the wilderness of the unknown, or into swamps and briar patches, but not all knowledge gained through them is useless. The harm comes in that the travelers entering them have no knowledge of the main highway, and think that these paths are the only ones, and are able to persuade others to their way of thinking. Time and education alone can restore them to the road of science and common sense, but in the meantime, they are adding something of value to our knowledge, if we will but learn. At present, the devotees of these various methods of treatment are content with the outland to which they have gone, and have no desire to return; but is it not the fault, in part at least, with the regular medical profession for failing to observe and practise, to teach in the schools observation and practise, of all that it of benefit to the sick and ailing, instead of practically denying that which cannot be demonstrated in the laboratory, or proved by experiment?

MacKenzie has forcefully called attention to the present condition of putting younger men into the out-patient work in our hospitals, and having experienced men in the wards, thus putting upon those without experience, the task which they are incompetent to handle, of recognizing the early stages of the disease, and giving to the supposedly experienced observers, the handling of the very sick in whom the signs and symptoms are marked. The young men who have the task of recognizing disease by its early symptoms have been trained in the hospital wards, and in the laboratories, and have learned to put their dependence upon physical signs and laboratory examinations, and in the rush of a busy clinic, they do not take the time to study the cases from any other standpoint. Now, I think we can go a step farther, and, following the old adage, "As the twig is bent, so the tree is inclined," say that the majority of these men never get much farther than to base their diagnoses largely upon physical signs and analyses.

The study of pathology is an absolute necessity to one who would have a knowledge of medicine, but if we get into the habit of thinking a disease must present the pathology as taught and seen in the autopsy room before we make a diagnosis of that disease, we are many times of very little use to the patients, because we fail to recognize the nature of their ailments while they are yet in a curable stage. In recent years, more attention has been paid to the functioning of organs, and by this means, a marked advance has been made, which is of benefit to the patient; but even here, the study of functioning has been through laboratory experiments, and only the more marked cases of abnormal functioning have been demonstrated.

The sidepath which I wish to call to your attention tonight is endocrinology. In the student days of most of us, we were taught that there were such glands as the pituitary, thyroid, thymus, adrenal and the ovaries. The part played by these glands in the economy of the system was about as vague as was the use of the appendix. Recently, however, much study has been given to them, and an effort made to determine their functions. This has been done either by giving the dried gland substance or its extracts, and the observing physiological effects produced, or by removing the

glands and observing the changes which take place.

In this paper I shall limit myself to the thyroid. The extremes in abnormal thyroid states are exemplified on the one hand by exophthalmic goitre, and on the other by cretinism or myxoedema. These do not enter into the scope of my studies. My studies have been for the most part on cases which do not present the marked symptoms produced by toxic amounts, or the complete absence of the thyroid extract, but on cases in which the abnormal variations are slight, yet enough to produce abnormal symptoms, especially with reference to asthma. It is my belief that many cases of asthma are due to an abnormal functioning of the thyroid, and manifested before the changes in functioning can be determined by the tests on metabolism. I have long believed that many cases of asthma were due to some abnormality of the nervous system, though what the abnormality is, I did not know. I have never been satisfied with the theory that asthma is due to a special sensitiveness to certain proteids, although I have been ready to acknowledge and treat cases on the basis that certain proteids may bring on the attacks; but, just as nervousness or an abnormal functioning of the sympathetic nervous system is unsatisfactory in that it does not explain the origin of the trouble, so is this sensitiveness to proteids unsatisfactory in that there must be something to cause this abnormal sensitiveness. For a couple of years, I have stopped paying much attention to the proteid sensitiveness, but have tried to find some deeper explanation which will account for both the sensitiveness to the proteids and the asthma.

I am studying the question from the standpoint of the endocrine glands. I have had sufficient success using the thyroid as a basis, so that I am now working chiefly with that. I have not, however, reached such a point that I am ready to make any categorical statements, or to claim that I am going to cure all cases of asthma; but I am giving you this as an informal statement as to what I am doing, and what results I have obtained. I know that there are many who hold that the metabolic test is necessary before we can make statements as to the excess or deficiency of the thyroid secretion. With this I do not agree. Not that the test is not of value when we get positive results, but that the test is not sufficiently delicate or pathognomic for the early cases, which, however, are sufficiently abnormal to cause asthma. I am much interested in the article in the *A. M. A. Journal* of April 10, by Dr. Woodbury of Clifton Springs, N. Y., reporting twenty-nine cases of hyperthyroidism operated upon between July 1, 1919, and January 1, 1920. He divides this group into two main types; first, the severely toxic cases showing marked positive epinephrin chloride reaction, and increased metabolic rate varying from 20 per cent. to 85 per cent.; second, a type showing symptoms milder in degree and without exophthalmos. The second type responded positively to the epinephrin chloride test in varying degrees, but showed a metabolic rate which was low, or not increased above the limits now accepted as normal. He further states "that there is a rather large group of patients who are in a definitely impaired physical and nervous condition, who, because of a toxic state of probable thyroid origin, are in need of positive medical or surgical aid, and yet whose metabolic rate is not increased."

Now, coming back to MacKenzie, I believe here is an instance in direct line with his argument for more exact clinical observation and study of symptoms without reliance upon physical signs and laboratory tests. Although I have been studying this for some time, I am not yet able in many instances to differentiate between the hyper- and the hypo-thyroid cases except by therapeutic tests. At one time I thought I had some fairly good symptoms for differentiation, but they failed me. While I can guess nearer than I used to, I cannot positively tell. The physical standard of an enlarged thyroid by itself is of no value, for as you all know, this enlargement may be an increase in the gland, the thyroid substance proper, or it may be the result of disease, impairing the function. Headache, I used to consider as an indication of hyperthyroidism; but the worst headache I have ever seen, was due to hypothyroidism. A condition of nervous excitement is common with hyperthyroidism, but I have seen it with hypothyroidism. A sluggish condition accompanied by inability for marked mental or physical exertion, I associated with hypothyroidism; but I have seen it a number of times with hyperthyroidism. And so it is through the whole list of symptoms which these people may give, so that at the present time, it seems to me that the symptoms obtained by both hypo-and hyperthyroidism are due to instability of the nervous

system produced by the abnormal functioning of the thyroid without, so far as I can yet determine, anything pathognomonic of either state.

Before going on to report some asthma cases, I will state that my interest in this subject was first aroused by some functional heart disturbances and my medical treatment of the hyperthyroid cases has followed the line which I used with some success in treating certain functional heart disturbances. An interesting incident, while treating one of these cases, though at the time I did not associate the patient's condition with the thyroid gland, has helped me more than once since. This patient was sent to me by a gynecologist for treatment of the heart condition. I was enabled to relieve the heart condition, and at the same time, she got well of a membranous colitis which she said the doctor who sent her to me had never been able to relieve. I have since tried this method of treatment on several patients with a diarrhea which others had never been able to relieve by ordinary methods. One was a patient at the tuberculosis clinic this year who had been a sufferer from diarrhea for years without getting any relief, and was sent to me to investigate as to tuberculosis. Within two weeks, his diarrhea was completely relieved. Another, a patient in my office, came to me with practically the same history, and she, too, was relieved of the symptoms of diarrhea. After a few weeks, she came back with some return of the trouble, though with nothing like the previous severity. I have not seen her since, and whether this symptom has remained in abeyance, I do not know. Another case of extreme interest to me was a child eleven years of age, whose mother, grandmother and aunt were extremes of the so-called nervous type. Both parents died of pneumonia. Among other symptoms the child suffered from a diarrhea which the physician living near them in the country was unable to relieve. She was taken to another physician at a distance, who diagnosed the case as tuberculosis. The child was living with an aunt and her husband who are relatives of mine. As soon as the diagnosis of tuberculosis was made, they consulted me, and the aunt being a trained nurse before marriage, I got an excellent description of the child, and felt that I could say her trouble was not tuberculosis, and that it probably was hyperthyroidism. I treated her upon this basis, and am pleased to say that the diarrhea disappeared, and there has been a marked improvement in the child, so that she is now not only free from her diarrhea, but able to attend school regularly, which she could not do before, and is much better in every way. One time this winter the medicine I sent failed to reach them, and she herself felt the lack of it so much that she sent word to me that she wished I would send her some more, because it made her feel better. In the children, I believe, my experience enables me to say that after a time, the treatment can be discontinued gradually, giving it only temporarily, as symptoms appear, and ultimately, the child will become normal. These instances I mention merely incidentally with a suggestion for further observation and study.

The treatment of the hypothyroid cases is easy. The treatment of the hyperthyroid cases in the early stages is not so simple. When the disease is advanced, the problem is a different one, and I do not consider it within the scope of this paper. If the symptoms are pronounced, and have lasted for a long time, I cannot believe that medicine holds any great hope for cure. I have sent a number of these cases to Dr. Peckham for x-ray treatment, and have been pleased with the results. It seems to me that in the milder cases, the over-activity of the thyroid is often intermittent, and, as we know, the activity of the thyroid is increased by any excitement, either mental or physical; that this increase of over-functioning is progressive; that, taken at its beginning, this increase in thyroid activity can be lessened by medical treatment, and its ordinary subsequent progress and climax or explosion can be prevented. In youth, this regulation for a time, I believe, may be sufficient to establish a normal stability and thus, if these symptoms can be recognized early, many cases can be prevented from becoming life-long invalids.

As I have stated, my treatment of these cases started before I had any clear idea of what I was treating, and I have continued the same method with a good deal of success, but on the theory that hyperthyroidism is the probable cause. The generally accepted medical treatment of hyperthyroidism is rest. This needs to be mental as well as physical, and this I try to employ in these milder cases, as far as is practicable, varying the degree of rest in accordance with the severity of the symptoms and the environment of the patient. My further treat-

ment is the use of some drug of the sedative group. Bromides I have not found satisfactory. A probable explanation of the action of a sedative is both to lessen the secretion of the thyroid gland, and to lessen its effect upon the nervous system, and thus in two ways lessen the effect upon the organs of the body. Before the war, I used a combination containing asafoetida, sombul and apomorphine. During the war, the drugs were not obtainable except at exorbitant prices, and then were unreliable, and I fell back upon the old formula containing camphor, hyoscyamus and valerian, and recently I have used hyoscyamus, valerian and sombul. I am hoping to find something better, but the results I have to report were obtained by these. I sometimes use iodine, though I am not satisfied as to its benefits. I use it because of its advocacy by others upon the theory that the function of the thyroid gland is largely to furnish iodine, and that if this is furnished in some other way, the necessity for the gland's activity will be lessened, and the secretion will lessen, and the toxicity will become less. The most evidence I have in favor of it is that I have relieved many cases of asthma in children by the use of iodine and a tonic, my favorite being iron and calcium phosphate. In the treatment of adults, both in the hyper- and hypothyroidism in the cases under consideration, I also use a tonic; but have learned that in the hyperthyroidism, the symptoms are aggravated by anything which contains strychnine.

The following cases are mentioned as examples of results in asthma on the basis of endocrine gland treatment:

CASE 1. L. L., male, aged 11. Maternal great-grandmother had asthma; also, probably, maternal aunt. Began to have asthma November, 1912. Tonsils and adenoids removed 1913, without any improvement. Has trouble winters; no asthma summers. Tested thyroid and found supersensitive; then given sedative treatment as described above, and now, one year later, is getting along very nicely. Has had no severe attack since beginning present line of treatment ten months ago.

CASE 2. M. E. B., female, aged 54. Always had bronchial trouble; asthma for ten years; came on gradually, now constantly for a year; tires easily; terrible pounding headaches mornings and evenings five years ago, then they left for a short time; steady all summer. Feet always cold. Burning asthma powder at night. Given varium, 5 grains, three times a day. She now reports it seems good to feel like going somewhere and seeing people; never used to go anywhere or see anyone. If people came to the house, she wanted to get away from them. Now has no occasion to burn asthma powder, and but very little trouble in breathing.

CASE 3. J. H., male, aged 41. Began to have asthma, 1914. Seen by me, April, 1917, in an attack which started about December, 1916. Attacks would come on at 6 or 7 P. M.; get worse after going to bed. Again he would awaken 2 to 4 A. M. Burning an asthma powder and using Tucker's Asthma Remedy. When I saw him, he had just returned from a southern resort, where he had been given an autogenous vaccine, a bottle of which he brought home, and which I started to use on him. Following the second injection, he had a severe chill, and his condition became much worse, so that he was kept in bed, and had a trained nurse. I then found the temperature was running 95 to 97, and that he had always been extremely sensitive to the cold. He was put on thyroid extract, maximum dose, 2½ grains three times a day. After one month's treatment, he was nearly recovered, and had warm hands and feet for the first time at that season of the year. By using a small amount of thyroid, he has kept in good condition since.

CASE 4. E. P. B., male, aged 20. Had influenza nine months ago; bronchitis and asthma since then. Has to sit up some at night. Troubled with cold hands and feet; has headaches. Temperature, 97.6; pulse, 72. Was never very active physically; is effeminate in appearance and voice. Was given thyroid extract, 2½ grains; gradual improvement until at the end of three months, the temperature was normal for the first time. He felt better, but was still nervous; not sleeping well. Two months more and there was marked improvement; the voice became more masculine. One year from the beginning of treatment he was perfectly well; temperature normal; taking 2½ grains thyroid extract every twenty-four hours.

CASE 5. B. G., aged 11. Eczema since a baby. Asthma since four years of age. Perspires easily; headaches occasionally; ear sick on electric or steam cars or in closed automobile. Given iron and calcium phos., camphor, hyoscyamus and valerian. Six weeks later, mother reported child was having no trouble; had a cold recently, but no asthma; that she is a completely different child: more even disposition, skin clear and cheeks red; does not get so nervous in school work; is much better natured; stands much more from brother two years older; fools more with him instead of getting into tantrums.

CASE 6. A. F. C., male, aged 47. Had bronchial trouble 17 years; more severe last five or six years; worse at night between 2 and 3 A.M. Headaches two weeks steady, off and on, for

years. Perspires easily; considerable tremor to hands. Never could eat eggs or bananas without much distress. Given thyroid as test, and found supersensitive. Given sedative treatment as above, and at the end of five months, can eat eggs and bananas freely. No longer has that "tired and dragged out feeling." Instead of coughing for an hour, he coughs about fifteen minutes at 3.30 A. M., and about ten minutes on getting up. The rest of the twenty-four hours, he is very comfortable.

CASES IN WHICH BASAL METABOLISM MEASUREMENT IS USEFUL.

By Oliver H. Stansfield, M.D., Worcester, Mass.,
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The splendid results from investigations into the normal and abnormal physiology of the thyroid gland have given us a more definite knowledge of the diseases of that organ. This is especially true of states of hyperthyroidism, in which estimation of basal metabolism provides a standard for judging severity, hence for a more uniform plan of treatment, and for accurately following progress.

The diagnostic value of measurement of the basal metabolism is also very great, particularly in that large group of ailments, the neuroses, and in clarifying such cases as contain a thyroid element of unknown influence. Examples of these obscure cases are presented in abstract, below, and, although notes cannot convey the sharp impression made by observation, yet they do show in what type of case, knowledge of basal metabolism is useful, or, in view of the lack of adequate clinical criteria, is even necessary.

Case 1. A woman, 42 years old, complained of headache and nervousness of eight months' duration. The headache recurred frequently, and was "dizzy, not violent." Irritability of temper, nervousness, attacks of palpitation of the heart, and dyspnoea on exertion also were present. During the first two months of illness she received twelve doses of arsphenamin and then was advised to follow a course of mercurial injections, and had her teeth extracted. No improvement was noted after this treatment. She had lost fifteen pounds in weight. Her appetite was good. There were no gastrointestinal symptoms. No menstrual disturbance was noted. The past history was unimportant.

On examination, psychic instability was evident. There was a periodic widening of the eyelids, causing a transient stare, but there were no other eye phenomena. No tremor of tongue and only a very slight tremor of the fingers was present. The thyroid was not enlarged, but was quite soft. The heart was negative; the rate during fourteen days, from 78 to 94. The blood Wassermann was negative. There was no lymphocytosis. A prolonged high blood sugar followed oral administration of 100 gm. glucose. X-ray showed a moderately enlarged thyroid, but not intrathoracic. The basal metabolism was 152% above normal.

The several points of interest in this case are: the, to palpation, normal-sized soft thyroid, the transient stare, the absence of frank signs of hyperthyroidism, especially the absence of tachycardia. The consistency of the gland would seem to be connected with the disturbance of function, but without microscopic examination nothing can be stated on that point. The transient stare is perhaps a forerunner or abortive form of exophthalmos and is probably as significant. The absence of outspoken tremor and tachycardia, particularly the latter, are features to be particularly noted, for they are apt to lead to error, as in this case, the final suggestion as to diagnosis having come from the brief stare. From the above, it seems necessary to add hyperthyroidism to the possible causes of neurasthenia.

Case 2. A Russian Jewish woman of 40 years, whose complaint was nervousness and weak spells. She was referred by her physician, "largely for the sake of the family." For five months she had suffered from a soreness in the epigastrium, with frequent feelings of weakness. She has had nocturnal attacks of gasping for breath, accompanied by a tight feeling in the chest. Her appetite was poor; she was constipated, but had no other gastrointestinal symptoms. She worried about the housework and, apparently, everything else.

The past history suggests a longer duration of the condition than five months, inasmuch as she had frequent headaches since a motor car accident three years before. A miscarriage five years before had resulted in a shorter intermenstrual period.

On examination, she was anxious and depressed. There were no ocular abnormalities. The thyroid was somewhat enlarged, firm and smooth, with no *bruit* audible over it. The heart was not enlarged, had but a poor muscular tone to the first sound of the apex, and a rate of from 70 to 86, during three weeks. There was no tremor of tongue or fingers. The hands were cold and moist. The blood Wassermann was negative. A lymphocytosis of 57% was found. X-ray examination of gastrointestinal tract was negative save for slight general ptosis. The basal metabolism was 111% above normal, and again six days later, it was 113% above normal.

Except for the enlarged thyroid, this patient seemed to present no signs pointing to the gland as responsible for her condition, the blood picture not having been correctly assessed. Nevertheless, she was suffering from a marked hyperthyroidism, as shown by the basal metabolism. The consistency of the thyroid in this patient is in contrast to that of the first case. This patient also had a relatively slow pulse, as in Case 1, but in addition, gave evidence of some heart muscle weakness, possibly because of longer duration of the disease. In any event, it is necessary to detect hyperthyroidism, under these circumstances, as early as possible, as there is less favorable response to treatment, than when a proportionately rapid pulse is present.

(Such instances as these suggest that perhaps Xanthippe may have been hyperthyroid, and that similar modern personalities may be remediable, to a certain extent.)

Case 3. A youth of 20 whose complaint was goitre. Four months before examination, he noticed palpitation of the heart, and was found to have an enlarged thyroid. He had felt no dyspnoea, and had retained his equanimity. At the time, he was working at heavy work for 80 to 85 hours a week. His appetite was good, and he had no gastrointestinal symptoms. The palpitation disappeared after a few weeks and did not reappear.

The thyroid was normal, except for a slight soft enlargement of the right lobe. There was no tremor of the tongue or fingers. The heart was negative; rate 72. There were no abnormal eye signs. The skin was warm and dry. The basal metabolism was 6% above normal. Six weeks later, during which interval he had pursued his studies at a technical school, he still presented no symptoms, and the thyroid seemed to be smaller than before.

This patient required no active treatment for hyperthyroidism, in spite of the suggestion from the enlargement of the gland and the palpitation.

It remains to be seen whether the retrogression in this case is permanent or a remission. The occurrence of retrogression of this sort, with the patient under a considerable mental strain, is interesting because of theories of causation of hyperthyroidism.

Case 4. A man of 27 years. Complaint, "Anemia." The patient supposed himself anemic since he was pale and lacked zest for life in general. He felt a fluttering of his heart frequently, and was dyspnoeic on exertion. He had frequent headaches and was tremulous after excitement or exertion. He had lost no weight.

The patient had done front line duty with the A. E. F., until he acquired a chronic bronchitis, for which he still received low compensation.

Appetite was good; he was a "faddist" on the healthy diet. On examination, the man was pale by reason of complexion, but not anemic, thin and somewhat anxious looking. He was a rather too conscientious person, and lacked self-confidence. The eyes were normal. The thyroid was slightly and uniformly enlarged. There was no tremor of tongue or fingers. Lungs and heart were negative; pulse rate, 80. The patient flushed easily. Basal metabolism was 4% above normal.

Apparently the enlarged thyroid in this patient did not indicate toxicity. This is interesting, since the diagnosis of effort syndrome seems proper.

Case 5. A girl of 16 years. Complaint, rapid and forceful beating of the heart. After severe tonsillitis six months before, she had noticed this rapid heart beat, and had become irritable, nervous and listless. The thyroid had enlarged at this time. Her appetite was poor. She was constipated but had no other gastrointestinal symptoms. She had lost weight. Frontal headaches occasionally appeared.

On examination, the patient was depressed. The eyes were normal. There was no tremor of the tongue or fingers. Slight cyanosis of the finger-tips was noted, the hands being cold and moist. The thyroid was moderately and uniformly enlarged, somewhat soft, without *bruit*. The heart was enlarged to the left, and presented presystolic and diastolic murmurs at the apex; pulse, 132. The lungs were clear. No edema. Basal metabolism, 17% above normal. After eight days' rest, the pulse was 132.

This girl had evidently acquired a mitral stenosis at the time of the tonsillitis, as well as an enlarged thyroid. The absence of signs of heart failure pointed to the tachycardia as probably due to the thyroid. The basal metabolism was slightly above the normal variation (10% below or above) and seemed to prove this theory. The poor response to a short rest may be additional proof. In any case, this is a good illustration of the aid received from estimations of basal metabolism in obscure cases.

These brief notes serve the purpose of showing wherein lies some of the value of basal metabolic determinations. Another point to be brought out is, that once the possibility of hyperthyroidism in aberrant form is realized, the number of examples is seen to be great, and therefore, important. In addition, there arise for solution, many very interesting problems.

Book Reviews.

Chronic Traumatic Osteomyelitis. By J. Renfrew White, N.B. (N.E.), F.R.C.S. New York: Paul B. Hoeber. 1919.

The prophylaxis of osteomyelitis presents a problem which, although many claims for its solution have been advanced during the course of the war, yet still is attended by many difficulties. Reports have been made of successful results obtained by various workers, yet the author of "Chronic Traumatic Osteomyelitis" believes that these cases doubtless refer to operations performed under especially favorable circumstances. There are, at the present time, in all the countries which have been engaged in the war, thousands of men suffering from chronic osteomyelitis; the unprecedented number of these cases emphasizes the urgency of considering thoroughly the pathology and treatment of this disease. This book has been prepared in the hope of offering to the profession some assistance towards the realization of an adequate method of dealing with this disease. The author has considered the physiology of the bone, the phenomena of osteomyelitis, the pathology of compound fractures and of chronic traumatic osteomyelitis, the chemical course of chronic traumatic osteomyelitis and the general principles and details to be followed in the treatment of chronic traumatic osteomyelitis. The book is illustrated by excellent plates, and contains the records of a number of cases.

Use of Factory Statistics in the Investigation of Industrial Fatigue. By Philip Sargent Florence. New York: Columbia University. 1918.

The importance of the relation between fatigue and industrial activity is being recognized more and more as a matter not merely of personal concern to the worker but also as a vital economic element. At the present time, the subject is being systematically investigated by organized workers who are testing by practical experience methods which may or may not prove to be theoretically sound. A statistical survey of industrial fatigue in factories has been made by Philip Florence, and his methods of research, presented in this volume, *Use of Factory Statistics in the Investigation of Industrial Fatigue*, will be of interest and value to workers in this field. The statistical method involves several steps before the actual data may be obtained; a general visit to the factory is necessary and industry must be prepared for statistical investigation before the facts can be collected from the record books; then individual methods must be generalized and the data explained on some basis of cause and effect. The elements of fatigue and its relation to the human organism and working capacity, as well as various industrial systems in which are involved factors which may predispose the human organism to fatigue, are clearly presented in this volume. Three methods of investigation are mentioned and compared: (1) laboratory experiment, (2) observation of actual conditions, and (3) the statistical method. It was the statistical method which was employed in this investigation for the purpose of discovering variations in working capacity and the influence of length and intensity of activity, the process of learning by experience, factory conditions, the type of worker, and the nature of the work on industrial output. In the task of determining the position of the human element in the factory and in the industrial system, this book should be of considerable assistance.

The Establishment and Conduct of a Tuberculosis Sanatorium. By Charles B. Slade, M.D. New York: Bureau of Public Health Education. 1918.

A monograph recently published under the auspices of the New York City Department of Health describes *The Establishment and Conduct of a Tuberculosis Sanatorium.* It is helpful to have this information readily accessible in one volume. The author has based his observations on his personal experience as Examining and Visiting Physician to the Municipal Sanatorium at Otisville, N.Y., and presents in systematic form the information necessary to establish and conduct a tuberculosis sanatorium. The writer believes that a tuberculosis sanatorium should have three primary objects: treatment, education, and segregation; that fundamental principles involved in the treatment and control of tuberculosis include mainly, the discovery of existing cases, treatment of existing cases, and the prevention of new ones. In planning an institution where these objects can be attained there are many factors which must be taken into consideration: the site, with attention to the climate and altitude, contour of ground, water supply, soil, vegetation and shade; and the plan, with provision for the ultimate accommodation of not less than one to three per thousand of the population of the community for which it is established, with a reception unit, a men's unit, a women's unit, a children's unit, and an administration unit. Illustrations and detailed description of these units are included in this book. In the conduct of a tuberculosis sanatorium, the administration and staff, the selection of patients, their physical care, routine work, exercise, food, education, and recreation are some of the problems which the author of this book has set forth. The information presented in this volume, together with illustrations, and charts and record forms used at the Municipal Sanatorium at Otisville should be of interest and value to those who desire to promote the care and treatment of tuberculous patients.

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Medical and Surgical Journal

Established in 1812

An independently owned Journal of Medicine and Surgery, published weekly under the direction of the Editors and an Advisory Committee, by the BOSTON MEDICAL AND SURGICAL JOURNAL SOCIETY, INC.

THURSDAY, MARCH 3, 1921

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Papers for publication, and all other communications for the Editorial Department, should be addressed to the Editor, 126 Massachusetts Ave., Boston 17. Notices and other material for the editorial pages must be received not later than noon on the Saturday preceding the date of publication. Orders for reprints must be returned in writing to the printer with the galley proof of papers. The Journal will furnish free to the author, upon his written request, one hundred eight-page reprints, without covers, or the equivalent in pages in the case of articles of greater length.

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BOSTON MEDICAL AND SURGICAL JOURNAL

126 Massachusetts Ave., Cor. Boylston St., Boston 17, Massachusetts

BOSTON MEETING OF THE AMERICAN MEDICAL ASSOCIATION.

WE have received recently notes regarding the activities of the Committee of Arrangements for the Boston meeting of the American Medical Association on June 6, 7, 8, 9 and 10. The following events have been planned tentatively:

On Wednesday evening, June 8, there are to be banquets connected with reunions of various organizations which will meet during the session of the American Medical Association. It is hoped that a large number of war organizations will meet at the banquets on that evening. From nine to ten o'clock, there is to be given a reception to the Association at the Boston Museum of Fine Arts, by the Trustees; this hospitality is greatly appreciated by the Committee.

Excursions to places of historical interest in and near Boston have been planned for June 8, 9 and 10. On the afternoon of June 8, the Committee of Arrangements will give a tea at the Harvard Medical School; this will afford members of the Society an opportunity to inspect the buildings. On the afternoon of June 9, there will be excursions to the estates of the Honorable Larz Anderson, Professor Sargent, and the late Mr. Louis Brandegee. On Thursday evening, there will be a reception to the President in Mechanics Hall. It is hoped that on Thursday, June 9, an excursion to Plymouth may be arranged.

The following physicians are included in the General Committee of arrangements:

Committee of Arrangements: Chairman, Dr. Fred B. Lund, 527 Beacon Street, Boston; Secretary, Dr. Richard H. Miller, 8 The Fenway, Boston.

Finance: Chairman, Dr. Hugh Williams; Secretary, Dr. Channing Frothingham, Jr.; Treasurer, Dr. A. William Reggio, 356 Beacon Street, Boston.

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Executive Committee, 35 Members.

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Sections and Section Meeting Places: Chairman, Dr. William H. Robey, Jr.; Secretary, Dr. H. A. Nissen, 205 Beacon Street, Boston.

Fifteen Sub-committees, with the following chairmen and headquarters: Medicine, Dr. D. L. Russell, Somerset; Surgery (General and Abdominal), Dr. F. H. Lahey, Lenox; Gynecology and Obstetrics, Dr. R. Wadsworth, Touraine; Ophthalmology, Dr. G. S. Derby, Vendome; Laryngology, Dr. D. C. Greene, Brunswick; Diseases of Children, Dr. J. L. Morse, Parker House; Nervous and Mental Diseases, Dr. J. B. Ayer, Young's; Urology, Dr. R. F. O'Neil, Westminster; Dermatology, Dr. C. J. White, Copley Square; Preventive Medicine, Dr. M. J. Rosenau, Bellevue; Orthopedic Surgery, Dr. R. J. Osgood, Adams House; Gastro-Enterology and Proctology, Dr. F. W. White, Essex; Pathology and Physiology, Dr. W. B. Cannon, Bellevue; Pharmacology and Therapeutics, Dr. Reid Hunt, Copley Square; Stomatology, Dr. E. H. Smith, Parker House.

Scientific Exhibits: Dr. Cecil K. Drinker, Chairman.

Sub-committee 1. Dr. Drinker. (Exhibit by Dr. Benedict.)—Sub-committee on historical loan exhibit of medical and surgical instruments.

Sub-committee 2. Public Health Exhibit.

Sub-committee 3. Commercial Exhibit; Dr. W. R. Morrison.

Hospital Clinics: Chairman, Dr. Joshua Hubbard; Secretary, Dr. Richard S. Eustis, 355 Marlborough Street, Boston.

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Guide-Book Committee: Chairman, Dr. Walter L. Burrage.

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MEDICAL NOTES.

Dr. Selskar M. Gunn in the Service of Czecho-Slovakia.—Dr. Selskar M. Gunn has been appointed by the government of Czecho-Slovakia as technical adviser to the ministry of public health and physical education. Dr. Gunn was formerly associated with the Massachusetts Institute of Technology; for the past three years he has been associate director of the International Health Board of the Rockefeller Foundation. Dr. Gunn has sailed for Europe, where he will remain for an indefinite period of time.

Tribute to Major-General William C. Gorgas.—At a meeting held under the direction of the Southern Society of Washington on January 17, tribute was paid to the memory of Major-General William Crawford Gorgas by representatives from Latin-America, France, Great Britain, and the United States, for his achievement in the struggle against yellow fever. Among those who expressed appreciation of his work were Adjutant-General Peter C. Harris, Secretary Newton C. Baker, J. E. Lefèvre, chargé d'affaires of Panama's legation; Minister de Sespedes, A. de Alençar, ambassador from Brazil, and Minister Elizalde of Ecuador.

The New York Post-Graduate Medical School and Hospital.—The New York Post-Graduate Medical School and Hospital announces that there will be available this year six scholarships under the terms of the Oliver-Rea Endowment. The purpose of the Endowment is to award scholarships to practising physicians of the United States, to defray in full the expenses of tuition at the New York Post-Graduate Medical School. According to the wishes of the donor, physicians in the State of Pennsylvania will receive preference in the award of these scholarships. Applications may be sent to the President of the New York Post-Graduate Medical School and Hospital, 20th Street and Second Avenue, New York City.

The Parkin Prize.—In terms of the bequest made to the Royal College of Physicians of Edinburgh by the late Dr. John Parkin, Fellow of the College, a prize is offered for the best essay on certain subjects connected with medicine. The subject for the essay for the present period is, in the terms of the deed: "On the efforts of voleanic action in the production of epidemic diseases in the animal and in the vegetable creation, and in the production of hurricanes and abnormal atmospherieal vicissitudes."

The prize is of the value of one hundred pounds sterling, and is open to competitors of all nations. Essays intended for competiton, which must be written in the English language, to be received by the Secretary not later than 31st December, 1921. Each essay must bear a motto, and be accompanied by a sealed envelope bearing the same motto outside, and the author's name inside. The successful candidate must publish his essay at his own expense, and present a printed copy of it to the College within the space of three months after the adjudieation of the prize.

BOSTON AND MASSACHUSETTS.

Week's Death Rate in Boston.—During the week ending February 19, 1921, the number of deaths reported was 222 against 483 last year, with a rate of 15.28 against 31.16 last year. There were 35 deaths under one year of age against 81 last year.

The number of cases of principal reportable diseases were: Diphtheria, 84; scarlet fever, 85; measles, 69; whooping cough, 26; typhoid fever, 2; tuberculosis, 42.

Included in the above were the following cases of non-residents: Diphtheria, 20; scarlet fever, 7; measles, 5; tuberculosis, 7.

Total deaths from these diseases were: Diphtheria, 3; measles, 2; whooping cough, 1; tuberculosis, 18.

Included in the above were the following cases of non-residents: Diphtheria, 2 tuberculosis, 2.

Encephalitis lethargica cases, 5.

BOSTON SCHOOL PHYSICIANS' ASSOCIATION.—At the annual meeting of the Boston School Physicians' Association, held at the Quincy House on January 24, 1921, the following officers were reëlected: Dr. Francis P. Silva, President; Dr. Francis G. Barnum, Vice-President; Dr. Edward J. O'Brien, Secretary-Treasurer. Besides the above-named officers, the Executive Committee includes: Dr. Bradford Kent, Dr. Joseph A. Cogan, Dr. Edward J. Timmins, Dr. Solomon H. Rubin. Dr. Silva is assistant visiting physician at the Boston Consumptives' Hospital and instructor at the Tufts Medical School. He graduated from the Harvard Medical School in 1893.

Correspondence.

NEW METHOD OF BABY IDENTIFICATION FOR MATERNITY HOSPITALS.

Boston, February 17, 1921.

Mr. Editor:—

I am enclosing a brief article which I have written on a new method of infant identification which is now being established at Saint Margaret's Hospital and the Forest Hills Hospital.

The method is simple and effective and working so well that I am sending you this brief outline hoping that it may prove of interest to readers of the JOURNAL.

Yours very truly,
HERBERT L. JOHNSON, M.D.

Recent articles in the daily press on the possibility of confusing infants in Maternity Hospitals brings to light a situation which has long been a source of concern to those upon whom the responsibility rests.

While it is perfectly obvious that safety is paramount in any new method instituted, simplicity and economy are also essential factors. The much advocated system of foot-print identification adequately meets the first of these qualifications but its cost of administration and complex method of procedure prohibit it to the average hospital.

A safe, simple, economical method which I have recently devised is now being established at St. Margaret's Hospital, Dorchester, and the Forest Hills Hospital, Forest Hills, Mass. The entire equipment consists of two sets of aluminum tags made in duplicate form and numbered from one on, consecutively, the limit being determined by the number of maternity beds in use. A small hand seal press, the necessary aluminum seals, and silk cord complete the outfit.

The *modus operandi* is as follows: Two tags, each stamped with the same number, the silk cord and seal are all boiled up in a separate package with the delivery kit. The nurse in charge of the delivery room removes this equipment from its sterile package at the proper time and seals one tag around the neck of the mother by means of silk cord, aluminum seal and hand press (mentioned above), being careful to see that the silk cord is so adjusted as to prevent the removal of the tag over the patient's head. In like manner, the other aluminum tag is sealed around the neck of the infant before it is removed from the delivery room. These tags remain on the patients until just prior to departure from the hospital, when the baby is finally placed in charge of its mother. The number assigned to the mother and baby is duly recorded beside their name in the maternity ward book. A linen tag on the basket in which the infant is kept bears the name of the mother, date of delivery, sex, number of baby, and full name of physician.

The time consumed in the complete operation of tagging according to this method is greatly in its favor when compared to other methods now in use. Its other advantages are as follows:

1. It is absolutely safe in that it is impossible to remove the tags from the necks of the mother and child if they are properly adjusted.

2. It is convenient because the baby and mother can be bathed completely without fear of destroying identification marks. At nursing periods number one baby is sure to go to number one mother, and so on. The mother herself is able to check up in this way (a mental effect not to be scoffed at).

3. It is simple in so far as the entire operation can be completed by a student nurse.

4. It is economical because the complete outfit with a set of duplicate tags, numbered one to one hundred, and one thousand aluminum seals can be purchased for approximately $18.00.

The economy, simplicity, and absolute reliability of this method recommend its general adoption.

A REJOINDER.

Chelsea, Mass., February 18, 1921.

Mr. Editor:—

Inasmuch as you have seen fit to publish a communication from one Dr. R. Guralnick recounting his experiences in search of diphtheria antitoxin in Chelsea and attributing his lack of success to some ulterior motive, presumably on the part of the Board of Health, I desire to state, if you will permit me, for the benefit of any "foreigners" contemplating an "invasion" of Chelsea, that diphtheria antitoxin can always be obtained at the office of the Board of Health, City Hall, from 8 A.M. to 4 P.M., except on Sundays and holidays, and at the Frost Hospital on Bellingham Street, at any hour of the day or night.

Very truly yours,
GEORGE S. FENWICK, *Chairman.*

SOCIETY NOTICE.

HAMPSHIRE DISTRICT MEDICAL SOCIETY.—The next regular meeting of the Hampshire District Medical Society will be held at the Northampton State Hospital, Northampton, on Wednesday, March 9, 1921, at 4.00 P.M. The business session will be devoted to the discussion of legislative matters now being considered in Boston. The speaker of the day will be Dr. Walter Timme of New York City, who will talk on "Diagnostic Criteria of Disturbances in the Internal Glandular System," with lantern slide demonstration. Dr. J. A. Houston will open the discussion. Dinner will be served at the Hospital at the conclusion of the meeting by courtesy of Dr. Houston. Any physician interested is invited to attend.

E. E. THOMAS, *Secretary.*

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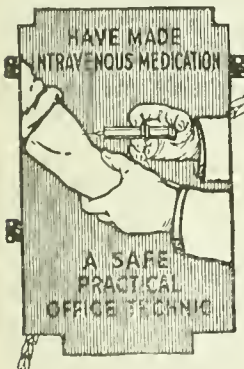

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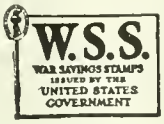

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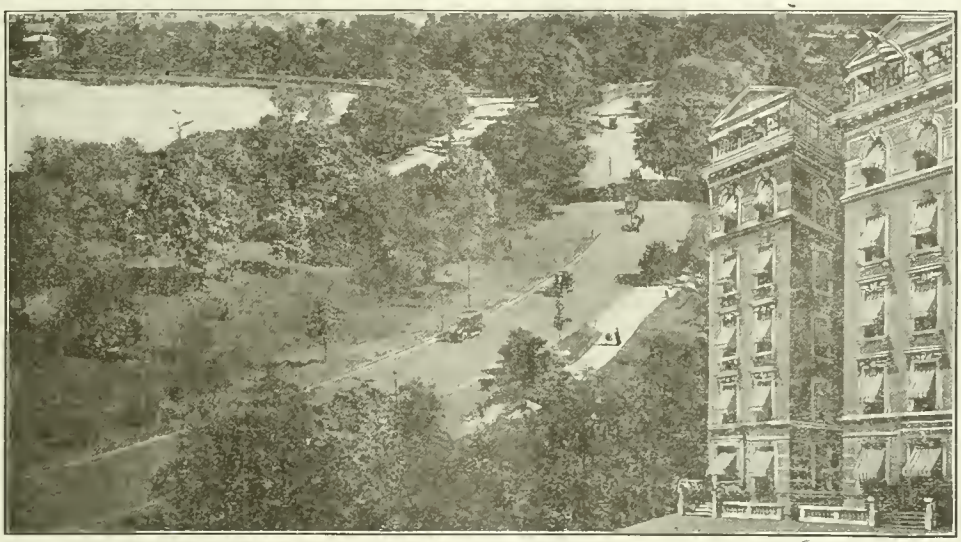

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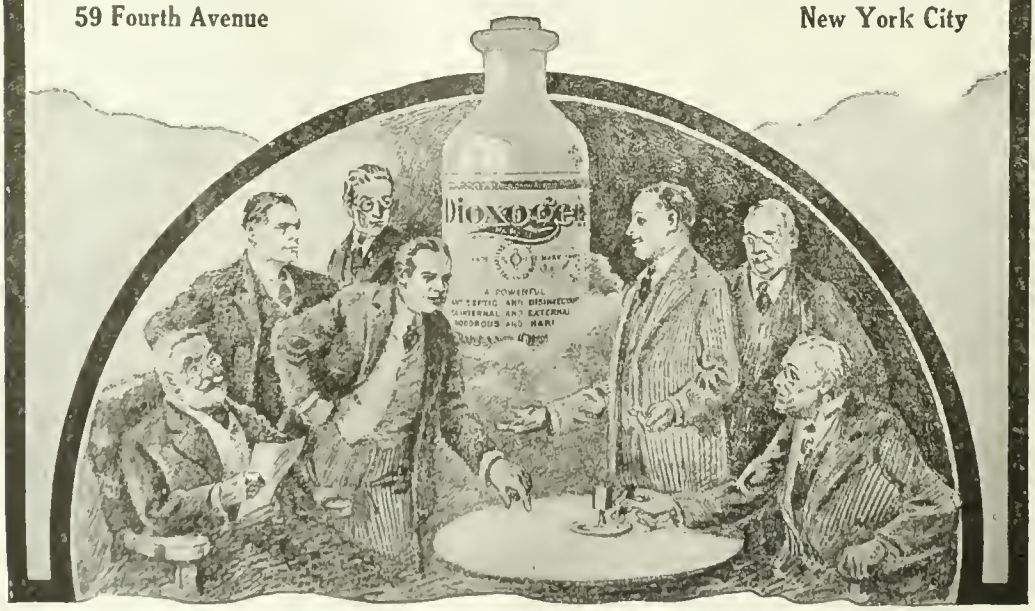

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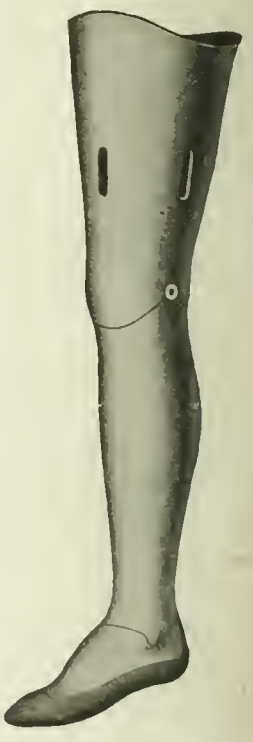

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